THE

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THE MAGNETIC AND ELECTRICAL PROPERTIES OF PURE SILICON-IRON.

FROM the point of view of the electrical engineer, no alloy of iron is more important than the low-hysteresis silicon steels, the remarkable magnetic properties of which were discovered by Sir Robert Hadfield nearly 30 years ago. The use of this material for the cores of transformers has in recent years increased by leaps and bounds, for high permeability, low hysteresis, and high electrical resistance are combined in the 2·5 to 4 per cent. alloys (of course, after special heat-treatment) in a way which renders them far superior to any other known material. From figures recently available, it would appear that not far short of 40,000 tons a year of this low-hysteresis material are being used in America alone, and there is a corresponding consumption in Europe. In a paper read before the Franklin Institute in 1910, the author, Mr. Martin G. Lloyd, estimated that there was then expended in America, to supply core losses in transformers alone, power costing nearly four million dollars annually. If one includes generators and motors, the figure for the present year may be anything from three to five times even this enormous sum. It is evident, therefore, that the use of low-hysteresis, high-resistance core material for electrical machinery is a matter of considerable national importance, and every improvement in existing materials must be eagerly studied by electrical engineers and quickly adopted if within the range of practicability.

In the current issue of the American Institute of Electrical Engineers, Mr. T. D. Yensen describes the magnetic and electrical tests which he has made on a series of *pure* instead of commercial silicon-iron alloys—that is to say, on alloys made in vacuo from pure electrolytic iron. The iron used in these experiments contained less than 0·01 per cent. carbon, and this fact is of peculiar interest, for it has been thought that the influence which silicon has on the magnetic properties of iron is to be ascribed, not to any direct action, but to the neutralising effect of the silicon upon carbon. It is evident from these experiments that some other explanation must be looked for. Microscopic examination shows that while a small part of the silicon reduces the iron oxide present, the remainder combines with the iron in solid solution.

Before being used, the electrolytic iron was crushed and thoroughly cleaned, and melted with the alloying element in a fused magnesite crucible in an Arsem electrical vacuum furnace working at a pressure of about 0·5 mm. of mercury. The ingots were forged into rods about ½ in. by 20 in., and from these rods 14-in. test pieces were prepared for the magnetic and electrical tests, and 2½-in. lengths for the mechanical tests; tests being made on the specimens (1) as forged, (2) after annealing in vacuo at 900° C. and cooling at 30° per hour, (3) after annealing at 1,100° C. and cooling at the same rate.

The addition of silicon increases the elastic limit and ultimate strength of pure iron in direct proportion to the amount added, reaching a maximum at about 4·5 per cent., where the yield point of the forged alloy is about 94,000 and the ultimate strength 105,000 lb. per sq in., some 8,000 lb. per sq. in. higher than the values for iron-silicon alloys containing carbon. Annealing has the effect of diminishing the mechanical strength of these alloys.

As first shown by Hadfield in the case of commercial steels, the addition of silicon to pure iron considerably increases its specific resistance, by an amount approximately proportional to the silicon content. The specific resistance of the 4·5 per cent. alloy is about 58 microhms at 20° C. That of the 3·4 per cent. alloy is 48·5 microhms; while the corresponding figure for commercial silicon steel is 51·2 microhms.

It is with regard to magnetic properties that these alloys show the most remarkable qualities. The induction curves (H — B) show two distinct maxima, one for a silicon content of 0·15 per cent. and the other at 3·4 per cent. The former is no doubt the point at which the iron reaches its maximum purity on account of the neutralising effect of the silicon on the small amount of impurities—carbon and oxide—present. Mr. Yensen is of opinion that the second maximum may be due directly to the action of the silicon, as Gumlich has shown in the case of iron-cobalt alloys, although there is some evidence against this; but the whole subject needs further investigation. Silicon, of course, is very closely akin to carbon chemically, and the silicon-iron combination deserves to be studied with the same thoroughness as the carbon-iron alloys. The complete phase diagram needs to be worked out—an admirable research for some capable research student.

But to return to the 3·4 per cent. silicon alloys. The astonishingly high values obtained for the permeability are without precedent in the annals of the magnetic properties of iron and iron alloys, the maxima rising to the extraordinary figure of over 60,000 in the case of the 0·15 and the 3·4 alloys annealed at 1,100° C. Mr. Yensen himself last year found a value of 19,000 for pure vacuum iron, while Gumlich and Goerens in 1912 made silicon alloys which had a maximum permeability of 11,600 for the 0·4 per cent. alloy, and 9,400 for the 4 per cent. alloy. The comparison with ordinary commercial silicon steel is, of course, even more striking, for the maximum value in the case of the latter is some 3,000, or one-twentieth of that for the pure alloys, while the hysteresis loss is as 10 to 1, and the maximum value of B as 3 to 1 in favour of the vacuum alloy. Even for the maximum value B = 15,000 the permeability of the pure alloy is twice that of the commercial steel, while the specific resistance is only just a little higher, namely, as 51 is to 48 in the case of the latter.

The new alloys will doubtless be prepared by other investigators and their properties re-examined, but Mr. Yensen appears to have taken every precaution in his tests, and there seems no reason to doubt that he has put the coping stone on the pioneer work of Hadfield by giving the electrical engineer two new most valuable iron alloys, one low in silicon content, not very strong but extremely ductile, of high permeability, low hysteresis and low electrical resistance, and another and more important alloy fairly high in silicon-content, very strong, moderately tough, of extraordinarily high permeability and low hysteresis, and of high electrical resistance. Possibly the cost of manufacture may turn out to be so high as to be prohibitive, but, in spite of the fact that the raw material must be prepared electrolytically and the alloy melted in an electric vacuum furnace, there is no obvious reason why this should be so, provided the material is made on a sufficiently large scale. This at least is a possibility which merits the most serious consideration on the part of the makers of electrical machinery and of the raw material indispensable for their efficient working.

Lead.

There has been a marked advance in the price of lead during the past few weeks, an advance which has taken everybody completely by surprise, and under the influence of which prices were driven to £28 for near delivery, while it is expected that a still higher range of prices will be established before the war comes to an end. There is no doubt that the upward movement is based entirely upon war consumption and war conditions. With statistics of production practically unobtainable, and with the curtain rung down upon consumption in all markets, the student of price movements is practically thrown upon guesswork in arriving at his deductions. All sorts of unexpected difficulties have conspired to stiffen up the market. Shipments from abroad have been restricted in many directions, and have sometimes been held up altogether, while when vessels do come to hand, the utmost difficulties and delays are experienced in getting them discharged. There has been extraordinary activity in connection with the supply of Russian requirements, and large quantities of lead have been purchased for Archangel, while some shipments are also intended to be made from here to Vladivostock. It had been feared that navigation to Archangel would have ceased ere this, but a number of ice-breakers are at work, and there seems a reasonable chance of the waterway being kept in a navigable condition for some time yet. At any rate, one steamer left here last week, and there is a boat loading this week at Liverpool for this port. The arrivals of Broken Hill soft lead are much below expectations, the reason being that large quantities are being shipped direct to Japan in order to supply the works engaged there upon turning out munitions for Russia. There is no doubt that this factor is playing a part here in the maintaining of a high level of prices. Spanish exports have been irregular this year, and some very small monthly totals have been returned. The English refiners complain loudly of the difficulties they are experiencing in connection with the labour supply, having large quantities of silver-lead available for treatment, but not having the men to deal with the stuff. Consequently, furnaces are idle, and the output of pig-lead is reduced. All things tend to set up conditions of stringency. Lead is scarce, and Russian consumption is on such a scale as to preclude the probability of there being any surplus metal available.

Italian Engineers and the German Yoke.

The annual conference of the Associazione Elettrotecnica Italiana was held at Leghorn in the second week of November, under the presidency of Signor Semenza, of Milan, and in the presence of those whose names are well known both in Italian science and in electrical manufacturing in that country. According to a brief report of the proceedings which has come to hand, the most important question before the conference related to the nationalisation of the electrical industry, in regard to which much has been accomplished through the statistical documentation of the electricity works in Italy, the cataloguing of makers of electrical and accessory plant, and the study of Customs tariffs with respect to the development and protection of national industry, the results showing facts of great promise. The conference also discussed the problems of foreign patents, the formation of Italian syndicates of constructors of electrical machinery and plant, and measures for the promotion of the financial organisation of the industry. The final conclusion, which confirms what we have recently set forth in this journal in regard to Italian electrical engineering firms, was the expression of great confidence in the promise of the industry securing emancipation from the Teutonic yoke (l'emancipazione dell' industria elettrica Italiana dal giogo Teutonico). The Italians, it is evident, mean business in trade as well as in war, as the conference unanimously selected Trieste (Austria) as the locality for the next congress.

TO ORGANISE BRITISH ENGINEERING INDUSTRY.

Many an important movement has had its origin in a club room. Last week we referred to an interesting scheme for the reorganisation of the electrical industry which was advocated in a Birmingham club meeting. To-day we give some particulars of another and even more ambitious club proposal which has been under consideration at Manchester for twelve months. Its very worthy object is the organising of the British engineering industry, which naturally embraces the electrical as one section of the whole. It is interesting to note that each of these proposals wishes to absorb the existing organisations in its field, avoiding waste of effort in some directions and adding to their operations in others making for strength and influence.

The meeting of the Engineers' Club which was held at Manchester on Friday, November 19th, was attended by 150 members, and it resolved to take immediate steps along the lines recommended by its Special Committee. It formed itself into a council which met on the following Monday, 65 members being then present. Several offers of subscriptions towards the initial expenses were made. A provisional committee was appointed to act for six months, Mr. H. W. Brady, being elected hon. sec. *pro tem.*, Mr. H. T. Wilkinson, who had acted in that capacity to the Special Committee, being unable to carry on the duties. The provisional committee will doubtless have to report in due course regarding what measures shall be taken to carry the recommendations into effect. Manchester is, of course, a very important engineering centre, and as its works are, for obvious reasons, exceedingly busy just now, the large attendance at both meetings shows how keen is the interest taken in the matter.

If the whole-hearted support of the industry and adequate financial backing can be secured the Manchester Engineers' Club considers that the success of its proposed organisation is assured. And it considers that that support and backing will be forthcoming if every British engineer approaches the matter in a spirit of pure patriotism. Therefore, given patriotism, the object which has been the occasion of such deep thought on the part of the committee will be reached. We suppose, therefore, if the scheme does not succeed we shall have to ascribe the failure to lack of patriotism. Possibly some of us would have preferred that the proposal should not be introduced in this manner. It may happen that there are other schemes in preparation which also lay claim to our patriotic support, and in such a case patriotism may have to discriminate between them. As a matter of fact there are several projects before us at the moment aiming at the more efficient organisation of our industries, and already several associations are more or less actively engaged. Each of them is working, or is designed to operate, in its own particular way, and recognises, along with the Manchester Club Committee, "that the British engineering industry must organise without delay to take advantage of present opportunities and to meet the conditions which will follow the termination of the war." But none of them is as strongly supported as it would wish to be. Unfortunately, associations such as we have in mind are in danger of overlapping, and by their multiplication much wasted effort, and perhaps some annoyance, may be occasioned. If the Manchester idea of "some voluntary organisation of a whole industry"—taking the form of an Association "on a non-trading and non-interference-with-prices basis"—could be carried into effect, bringing all existing organisations together in one great national association, the idea in theory, at any rate, would be admirable. How it would work out in practice is quite another matter. The British independent spirit is still very strong and it will so continue after the war, among associations as well as among individuals. It is not intended to banish that independent spirit, but to so organise it that it shall not have destructive effects within the industry.

We agree that the multiplication of such organisations is undesirable, and the Club seems to entertain some idea that an existing association might so modify its constitution and extend its operations as to include the objects of the present scheme. It is felt that it would be better to adopt that course, if possible, rather than to establish a new Association. We remember that one of the Associations has already through the lips of its secretary expressed its conviction in favour of a Federation of all such Associations. We remember also that some existing organisations are considered to have succeeded or failed, whichever way we please to regard it, by reason of price-regulation efforts. Is modification of constitution intended to imply alterations in this respect?

The prefatory note of the green pamphlet that lies before us seems to express the view that German and Austrian foreign trade is waiting to fall into the British lap if only we can build up an organisation "that embodies a broader and loftier view of the responsibilities, the opportunities, and the powers of our engineering industry." Well, that may be the case—it all depends upon what our word "organisation" means, how long it takes to get the said organisation to work, whether it is able to secure "co-operation between competing firms," and so forth. Trusts or combines "that enforce uniformity and stifle individual initiative" are not advocated, but in place thereof there is suggested a huge voluntary organisation of the whole industry "based upon a recognition of the interests common to competing firms and common also to employer and employed." By such voluntary organisation and co-operation "a great deal can be done to improve manufacturing processes, to develop foreign trade, and to secure for employés better conditions of work and a larger share of the fruits of their labours."

It is proposed that the new Association should aim at the inclusion of every British manufacturing concern in every branch of engineering, and, reckoning the capital of these concerns at 300 millions sterling, it would have an income of £300,000 annually. With such an income, "adequate financial backing," and "an efficient and energetic management," what would lie beyond its powers of achievement? It would still require that "whole-hearted support of the industry." It will be agreed that the constitution of the Association would require careful framing. It is proposed to restrict membership to *approved* British engineering firms, though it says that it ".aims" to get them all, and it considers that "a large majority, say three-fourths, of the beneficial owners of every company or firm seeking to become a member should be British subjects." But much appears to depend upon that "efficient and energetic management," that "thoroughly competent business man of unimpeachable integrity."

Having in the foregoing summarised in our own way the preamble and the conclusion, we may detail the work that it is intended to do through the medium of departments and standing committees.

The General Purposes Committee will endeavour to secure improved conditions and freights from railway, canal and shipping authorities; and by arbitration "or otherwise" it will settle disputes between its members, for it is recognised that even in an organised industry there will be differences arising.

The Intelligence Committee will control the Association representatives, will collect, analyse, and distribute technical and commercial information among members; it will analyse Consular reports, technical and commercial papers, and "other published matter," and circulate the result. It will receive "specific inquiries for business" and forward them to "firms indicated if earmarked," or to all members if not so earmarked. It will arrange conferences of members, and discuss general policy and joint action in connection with prospective business. It will send investigating engineering commissions to various parts of the world and will appoint individuals to report on particular fields, industries, or specific cases. It will give introductions, recommend agents, and make confidential inquiries regarding the standing of firms.

The Production Committee will first "promote a better feeling between manufacturers, to the mutual good," and, having done that, will raise the standard of manufacturing methods and organisation; it will stimulate manufacturers to adopt a progressive and enterprising commercial, technical, and manufacturing policy; it will induce members to experiment continuously, both on their own account and in co-operation with other firms or institutions, with a view to

placing new or improved productions on the market. It will encourage its members to study customers' requirements more keenly and to try to satisfy them, to issue comprehensive catalogues, to send abroad qualified representatives, and to fulfil promises of delivery! Finally, it will recommend members to consider the advisability of marking their goods "British made."

The Inventions and Patents Committee will make recommendations to the Parliamentary Committee respecting the law relating to Patents, Designs and Trade Marks.

The Publicity Committee will circulate the information collected by the Intelligence Department; it will distribute at home and abroad printed information relating to British engineering industry for the purpose of increasing the demand for British products. It will organise schemes for advertising by means of exhibitions, showrooms, and otherwise, at home and abroad. It will translate and adapt members' catalogues for the foreign markets, using the language and units of those markets and giving full prices, code-words and data; this will be done by native engineers so as to secure technical accuracy and adequacy of description.

The Finance Committee will see that the Association stands upon a sound financial basis, but it will also, we suppose incidentally, arrange for the better financing of industry, both for manufacturing and for home and foreign contracts.

There will also be an *Education and Research Committee* which will do a great deal of useful work and will encourage research, and lastly, a *Parliamentary Committee*. To this last will fall the difficult task of inducing the Government to take an active interest in trade in general, and engineering in particular, persuading it to create a Ministry of Industry and Commerce, whose departments will take over the purely commercial matters now handled by the Board of Trade. It will induce the Government to reorganise the Consular service and make it more useful; to appoint the right men as commercial attachés, engineers as advisers of national representatives abroad; to appoint natural-born British subjects as Consular officers wherever possible, and to secure that the service shall be a special medium for the furtherance of British commercial interests. This committee will also advise the Government on engineering matters "when called upon to do so," and it will deal with recommendations from the Inventions and Patents Committee and take action thereon when necessary or advisable.

Now, there is so much in the foregoing programme that we have advocated at different times that we give the Committee unstinted praise for the exhaustive nature of its study of the position. It began its deliberations last winter with a series of debates, at the first of which it was decided that it was essential that the engineer put his house in order. Prolonged study has shown how vast a work lies awaiting the organisation which takes that task in hand. It is not only the engineer's own house that requires putting in order —that should be its foremost concern; and if it succeeds in such a connection and induces every firm to come under its Association roof and "co-operate with its competitors" "without interference with prices" it may be strong enough to move mountains—even Parliament.

AN UNDERGROUND TELEGRAPH CABLE INSTALLATION IN PUEBLA, MEXICO.

By WILLIAM B. HALE.

Puebla, a city founded by the Spaniards in 1532, with a population about 100,000, has shown few signs of progress until recent years, when many civic improvements have been carried into effect. Modern water supply and drainage systems have been installed, asphalt pavements and cement sidewalks have been laid, and the principal streets are curb lighted by tungsten clusters on ornamental cast-iron pillars. Underground cables have been laid by the electric light and telephone companies, and the network of overhead wires which formerly disfigured the city has been removed.

The lines of the Federal Telegraphs had entered the city through an old 21-conductor, lead-covered cable, unarmoured, which was in bad condition. Open wire lines, or an aerial cable, could have been substituted for the damaged cable, but the Mexican Government decided to ensure uninterrupted telegraphic communication by laying a high-grade armoured cable in Puebla. The writer was commissioned by the Director of Telegraphs, Camilo A. Gonzalez, a very able and progressive official, to undertake the installation of this cable, which was supplied by Messrs. W. T. Henley's Telegraph Works Co., Ltd., of London, and conformed to the following specifications:—50 conductors

Fig. 1.—Federal Telegraph Building, Mexico.

of 1·6 mm. diameter (No. 14 B and S. gauge) copper wire, insulated to a thickness of 1·6 mm. paper with nine wrappings; saturated core; lead-sheath 4 mm. thick; tarred jute serving; double steel-tape armour, and outer covering of jute over all. The outside diameter of the cable was $2\frac{1}{2}$ in. (6·3 cm.), and its weight was $7\frac{1}{2}$ lb. per ft. (11·2 kg. per metre).

The old cable had been put down seven years before in a duct extending under the sidewalks from the telegraph office (fig. 1) to a cable house on the outskirts of the city —a distance of nearly one mile. At that time the side-

Fig. 2.—Cable Drum Mounted on Jacks.

walks consisted of blocks of stone laid on the ground, and it was an easy task to raise these blocks, dig a trench from office to cable house, place in it semi-cylindrical tiles, lay the cable in this open duct, cover with flat tiles set in mortar, and fill up the trench. Since then, however, the stone pavements had given place to cement sidewalks and asphalted streets, and the writer was confronted by the

alternative of opening up the conduit at a heavy cost, or of employing the drawing-in system. It was decided to adopt the latter method. Pits were, therefore, built at all street intersections to facilitate the work of installing the new cable. These pits are of brick, covered on the inside with a layer of cement. They are square, and have the following inside dimensions :—34 in. × 34 in. (86 cm. × 86 cm.), and 49 in. (1·25 m.) deep. The cast-iron pit frames are 39 in. (1 m.) square ; and the iron covers, 33 in. × 21 in. (84 cm. × 53 cm.), were cast with hollow tops, which were filled in with cement to match the sidewalks. The laying of an armoured cable in a conduit is, of course, an unusual procedure ; but, in this case, the ducts lacked the strength necessary to afford protection to an unarmoured cable, as shown by the fact that the old cable had been cut in many places by picks in the hands of the labourers who made the excavations for the water and drainage pipes.

As soon as the pits were finished, a small aerial cable was made by binding together eight No. 18 B. & S. gauge rubber-covered wires with insulating tape, and it was strung on the electric light company's iron poles from the telegraph office to the cable house. On account of its lightness, no messenger wire was needed to support this improvised cable, and it was rapidly strung by simply tieing it to the poles with pieces of No. 14 weatherproof wire. Temporary quadruplex communication was then established through the overhead cable, and the work of pulling out the old underground cable was begun. It was cut in all the pits, and drawn out in sections. To avoid the labour of rodding the ducts for the introduction of the steel hoisting rope which was used to install the new cable, a length of No. 8 B.W.G. galvanised iron wire was fastened to an end of each section of the old cable, and was drawn into the duct as the old cable was pulled out.

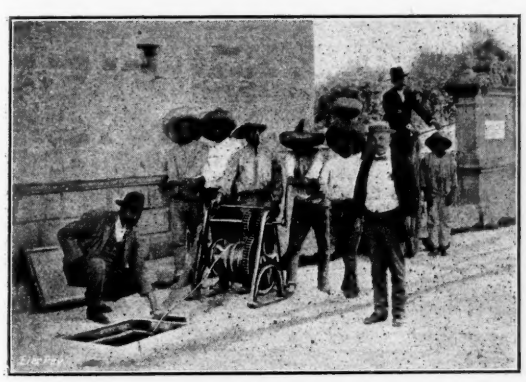


Fig. 3.—Drawing Cable into Duct.

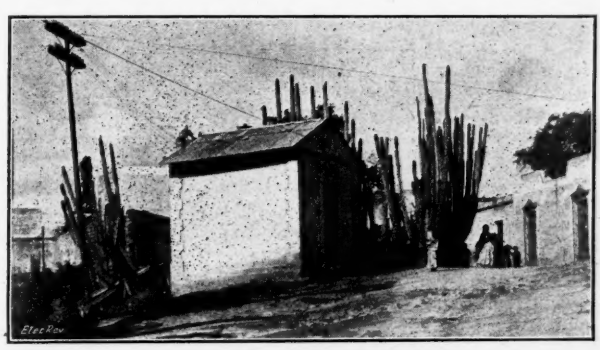


Fig. 4.—Cable House.

The installation of the new cable was carried out in the usual manner. Each drum, mounted on jacks, was placed by one of the pits corresponding to its section of conduit, a cable grip was attached, and the steel rope previously introduced into the duct was fastened to the grip, a swivel being inserted between the two. A cable winch was then mounted at the next pit, and, with two Mexican peons at each handle, the cable was pulled in. The drawing-in process, shown in figs. 2 and 3, occupied considerable time, the winch being too small for a cable of that weight. Much difficulty attended the laying of the last section of cable. The duct in this section contained a number of curves, and their resistance to the passage of the cable increased the tension to such an extent, that the winch was unable to move the cable. It was therefore necessary to open up the 420 ft. (128 m.) of conduit between the last pit and the cable house.

The jointing of the cable was done in the pits. Tinned copper sleeves were used to connect the wires, and every connection was carefully soldered and covered with a 3-in. (7·6 cm.) paper tube. The completed splice was thoroughly dried out by placing a lighted charcoal brazier on the bottom of the pit and covering the pit for about half-an-hour. The joint was then given two wraps of 2-in. (5·1 cm.) compound tape, and over this two wraps of ½-in. (13 mm.) saturated paper tape, kept in place by binding with linen thread. The lead sleeve previously put on the end of one of the lengths of cable was then slid into place, and wiped solder joints were made at its extremities. Finally, the completed joint was enclosed in a cast-iron joint box, which was filled with hot insulating compound.

Tests of the completed cable, 4,330 ft. (1,320 metres) in length, gave the following results, the values noted being the means of measurements on the 50 wires :—Conductor resistance, 11·16 ohms at about 15° C. = 13·6 ohms per mile (8·46 ohms per km.). Electrostatic capacity, 0·09 microfarad = 0 11 microfarad per mile (0·068 microfarad per km.). The insulation resistance of the cable was considerably in excess of 500 megohms per mile, but the sensibility of the galvanometer employed in the test did not permit of a more exact measurement. The differences between the maximum and the minimum values obtained in the tests of conductor resistance and electrostatic capacity of the 50 wires of the cable were small, and this uniformity was due to the care with which the joints were made.

Upon the completion of the tests, the cable was put into service by connecting the office end to its switchboard and joining the other end to the telegraph lines in the cable house, shown in fig. 4. A pothead splice was made on the cable in this house, using for the purpose pieces of No. 14 B. & S. gauge rubber-covered and braided copper wire, the ends of which were connected to a terminal board fitted with suitable fuses and lightning arresters.

The cable house is situated north of the city, at the foot of the hill on which stands picturesque Fort Loreto. This ancient stronghold was the scene of a famous battle, when, on May 5th, 1862, the Mexicans, under General Zaragoza, repulsed the attack of the French army of invasion. And to-day, the tower of the modern waterworks reservoir rising beside the battle-scarred walls of the old fortress, and the cable house not far away, offer silent but eloquent testimony to the era of progress into which the Republic of Mexico had entered before the outbreak of the present deplorable revolutionary disturbances.

Municipal Electrical Trading in Australia.—The Council of the Sydney Chamber of Commerce has adopted a recommendation of its Electrical Engineering Sectional Committee, deprecating the tendency of governing bodies to enter into competition with ratepayers and citizens in trading undertakings. The attention of the Chamber was drawn to the matter by the Electrical Employers' Association of New South Wales. The activity among municipalities in applying for power to carry out installation work on consumers' premises and the sale of fittings and apparatus, &c., called forth the protest, and the Electrical Employers' Association is to receive support from the Chamber in any reasonable efforts that it may make to deal with the matter.

An Edison Celebration.—The opportunity afforded by the San Francisco Exposition has been taken to apotheosise "the greatest living American—Thomas Alva Edison." He was "greeted first of all by 50,000 souls on his arrival, then by over 90,000 on Edison Day, then by 75,000 school children," and was *fêted* by the city administration and his old friends of the telegraph. On the latter occasion the speeches and toasts were all ticked out by sounders, not a word being spoken until, at Mr. Edison's request, Mr. Samuel Insull made an oral response on his behalf.—*T. and T. Age.*

ELECTRICAL ACCIDENTS IN MINES.

During the year 1914 there were in the mines of Great Britain 47 accidents reported to H.M. Inspectors of Mines, eight of which were fatal. Four of the fatal accidents occurred below ground and four on the surface, while of the non-fatal accidents 19 were below ground and 20 on the surface.

In the Scotland Division there was one fatal and three non-fatal accidents below ground, and one fatal and three non-fatal accidents above ground. Regarding the fatal accident below ground, it appears a little doubtful whether the man's death should be attributed to electricity, but even if this should be the correct determination, the deceased must have been guilty of more than as the report says, "ordinary carelessness." The accident occurred in a roadway where there was a four-way box, from which two coal-cutters and a small pump were supplied with alternating current at 500 volts. The fourth way was not in use. The box was hung on standards to suit the incoming main cable and the three outgoing cables. It was very heavy and strongly made, with a lid weighing about 1 cwt. hinged at the top. One person could not hold the lid open and at the same time insert or draw fuses; either a second person was necessary or the lid had to be propped up. It would appear that the lid had been propped up. When a coal-cutting shift was finished it was the practice for the machineman not only to switch off the current at the gate end box, but also to draw the fuses in the box above mentioned.

On the morning of the accident, about 6.30, the man who was killed was on his way outbye with another machineman, when they met the day shift fireman who was on his way inbye. The second machineman stayed to talk to the fireman for a moment, and the other continued on his way outbye. A moment or two later the second man followed the first one outbye, and on arriving at the four-way box found him lying at the side of the box with the fingers of one hand touching the bottom flange. The lid of the box had been apparently opened, but had fallen, partly shut, and was held from closing by a sleeper which had to all appearance been used as a prop. He was drawn away from the box by his neighbour, who did not feel any shock whilst doing so, and he and the fireman applied artificial respiration, but to no useful purpose.

Mr. J. Masterton, senior inspector, made an investigation of the occurrence, and he reported as follows:—

> The fuse box was left just as it had been till I examined it. The lid was held 7¼ in. open by an old pit sleeper 38 in. long. The sleeper was damp and greasy, and there was a mark inside the lid as if it had slipped there. One of the fuses of the pump circuit immediately under the end of the sleeper was pressed out of position, the knife edge of it was twisted, and the corresponding spring which should receive it was spread; the protecting insulating shield inside the box was bruised at the hole which the knife edge had been in.
>
> Two of the fuses on the coal-cutter circuit were drawn and lying in position, the third was only partly drawn, and it appeared to me as if the door slipped when he was just about to draw this fuse. Suppose this had occurred, the man would receive a very severe blow at the base of the skull. His chance, however, of receiving an electric shock, even when being knocked forward and down, was small, and his fingers would require to get through one of two 1¾-in. spaces between the insulating shields, which are purposely to prevent accidental contact. The fuses themselves are of the tubular porcelain type, with insulating protection outside the hand-grips to prevent accidental contact with live parts. Suppose the man did come into contact with a live part, the voltage he would receive would be 290 volts, and the average man can stand this, even three-phase, if he is not held in contact.

Mr. W. E. T. Hartley also made an inspection of the plant, and he reported as under:—

> There are three points where a shock might have been received, but only by very considerable carelessness. The ebonite tubes on the fuse-holders are secured by two small roundheaded screws. These heads are live when in use, and a hand placed outside the porcelain could touch one of them; again, with a fuse-holder half drawn, it is possible to lift a finger over the protecting flange of porcelain and touch the blade of the holder, which would still be live. The third point is the line work behind the protecting shield. This could be got at deliberately with ease, but by no chance when withdrawing a fuse. The most probable place for anyone to get a shock is the small screw mentioned above, and the contact would be made by the fourth finger of the right hand; after that the blade of the fuse, which would be touched by the same finger. In either case, however, more than ordinary carelessness is needed.

A post-mortem examination was made, when it was found that there were no visible bruises on the body, but there were two little blisters on deceased's hand, one on his little finger and the other on his right finger; several unusual conditions in the heart and brain were revealed. There was nothing about the head or neck to show that he had received a blow. The brain showed a little more fluid than usual, and the distinction between the white and grey matter was more obvious than customary. The blood was more fluid than usual. The valves of the heart controlling the delivery of the blood to the aorta were malformed, this defect probably being congenital, and being a well-known condition though not a common one. This lobe of the heart was, as a result, enlarged. The conditions were such that an electric shock might easily cause death, though, on the other hand, death might occur without any such stimulus. It was not probable that a blow, such as from the falling of the door of the distribution box, would determine death in this case where the man was accustomed to pit work.

Deciding on the balance of probabilities, the case has been classified as one due to electricity.

Of the three non-fatal accidents below ground, one accident occurred whilst an unauthorised person was replacing a fuse; the second was the result of a man, a fireman, taking off the outer glass of a lamp fitting, removing the lamp bulb, and attaching an old length of twin cable, which had been out of use for two years, to the circuit. The twin cable was faulty, and the fireman received a shock which might easily have been a fatal one, the voltage of the alternating current being 500.

The third case would appear to have been the result of using poor quality cables of German manufacture. The voltage of the circuit was 500, and the system concentric. A brusher was placing loose stones in the waste and had his hand over the cable when, without him touching it or moving it in any way, flame burst from it and burned his arm. It was the practice of the owners of the colliery to buy cable in half-mile lengths; the length from which the piece which failed was taken had not given satisfaction previously. This experience corroborates the injured man's statement that he had not touched or injured the cable in any way. The moral is obvious.

Of the accidents above ground, the fatal accident was entirely due to a breach of the rules of the colliery, and occurred as follows:—An underground attendant, just prior to descending into the mine at 3 p.m., handed to a boy, a lamp cleaner, a box of matches and a cigarette, asking him to hide them for him, and suggesting that they be put on the top of the switchboard in the lamp room. The boy hid the articles in the place suggested, the man in charge of the lamp room not being present at the moment. The attendant came out of the mine a little earlier than usual, all the coal having been got out, and, going into the lamp room, climbed up on to a cast-iron bench, and reached for the cigarette and matches placed on the top of the switchboard. His foot slipped on the bench, and his left hand came in contact with the fuse terminals. At the time of the accident electricity was being supplied in the form of three-phase current at 500 volts pressure, with the neutral point earthed. A motor-generator in the lamp room, used for charging accumulators, had its bed-plate properly earthed, as were also other parts of the plant. The fuse terminals and ammeter were 7 ft. from the ground, and were thus out of reach except by direct intention.

The man in charge of the lamp room had been warned some time previously against storing matches and cigarettes in the lamp room, and did not allow that to be done. In this instance, advantage was taken of his momentary absence. In addition, the attendant had no right to enter the lamp room. This accident also points to an absence of discipline.

(*To be continued.*)

OUR TRADING OPPORTUNITIES THROUGHOUT THE WORLD.

(*Continued from page* 679.)

The Trade of Russia.

That American Consular representatives in Russia are alive to the possibilities of trade development by other than enemy countries after the war, and by neutral countries during the war, is shown by the frequency of their appeals to American business men in their reports. Two such reports which have recently come to hand point to the difficulties which exporters must expect to meet, and to possible methods for overcoming them. The Consul says that the general ignorance, among Americans, of the Russian language will prevent the States from taking advantage of the immense business opportunities that will open after the close of the war. Though during the past year facilities have been placed at the disposal of British engineers and commercial men who are inclined to learn Russian, the following comments furnish useful reading for us as well as for Americans:—

The Russian Language.

"Until the war started, German was to a great extent the commercial language of Russia; the representatives in Russia of German firms usually took pains to make themselves proficient in speaking and writing Russian. Now, however, the German language is prohibited in Russia, so that Russian, hereafter, must of necessity be used in all but the few instances where Russian business men have a knowledge of English. There is considerable difficulty at present in Russia in securing competent interpreters for English-Russian conversations. A prominent American business man in Petrograd experienced great difficulty in carrying on negotiations of a rather delicate and complicated character through an interpreter whose knowledge of Russian was apparently perfect, but who did not know sufficient English properly to translate all the Russian. For about five minutes he would talk quite volubly with the Russian business man, and then would explain in two or three sentences in English all that had been said in Russian. This, of course, was unsatisfactory to the American, who wished to know everything the Russian had said. French is not so well known in Russia as is popularly supposed in the United States. While this language is used in diplomatic circles and in the highest society, it is not a commercial language, and is of little or no use for most business purposes. It is not understood at all by the masses of the people. While I was in the United States recently a manufacturer, who is contemplating a campaign for export trade in Russia, stated that he had had a large number of catalogues printed in French for circulation in Russia. French catalogues in Russia would be even less serviceable in securing business than poorly translated Russian catalogues."

Firms that contemplate sending representatives to Russia, when the war is over, or sooner, should ask such prospective representatives to start immediately to learn Russian. We hope that a goodly number of British electrical men are already equipping themselves. By hard study it may be possible to gather a fair working knowledge of the language for conversational purposes within six months. It is one of the most difficult languages in the world to learn, and it is only by constant painstaking study and practice that much progress can be made. But certainly it would be better for these representatives to learn the language themselves than to be obliged to depend altogether upon interpreters. Outside of Petrograd, Moscow, and Odessa it would be difficult to find persons who know English.

"It would seem as if the time had come when American colleges and universities, and especially all business schools, should introduce the study of Russian into their curriculums as a practical help to American business interests in cultivating closer relations with Russia. It would also seem to be a wise policy for American export houses to offer bonuses to such of their employés as would voluntarily take up the study of Russian. If a large number of Americans would during the next few months engage in the active study of Russian, the United States would undoubtedly be in a much better position to take advantage of the magnificent opportunities that the Russian market will offer. Nothing seems to please Russians better than to be addressed in their own language, even if it has to be done imperfectly. It is said that Russians like to hear their language spoken with an English accent, and even consider it fashionable to speak it themselves with an English accent. English governesses are largely employed, and there is discussion at present of the advisability of introducing the study of English in the schools. It would not be advisable, however, for Americans expecting to do business in Russia to wait for Russians to learn English."

British firms hardly need to be reminded that the geographical location of Germany, and her commercial peripatetic activities, have produced armies of Russian-knowing travellers who can run into Russia as easily as an American can get into Canada. Germany will not be robbed of the geographical advantage, nor will the travelling habit cease, after the war. If competent commercial men of this type have been killed at the front in any number—and we very much doubt whether that has happened—the deficiency will soon be made up.

Packing for the Archangel Route.

The report continues: "Until the reopening of the Baltic ports American exporters should give special attention to packing and crating goods billed to Russia, on account of the numerous transhipments before reaching interior points. These precautions should include special measures against exposure to weather. Goods arriving both at Archangel and at Tornea must be carried across a river by boat or sledge before being loaded on the railroad. Owing to the congestion of traffic at these points of entry, as well as at all interior points, goods frequently lie a long time under the open sky. Both routes now open were very little used before the war and are without proper warehouses, and the junction points on the Archangel route are inadequately supplied with such facilities. There is also a shortage of rolling stock on all railroads in this consular district. Goods moving inland from Archangel must at present be transhipped at Vologda from narrow-gauged cars. Goods for Russia from Finland are also transhipped at Petrograd."

Not Made in Germany.

Many articles of American manufacture, bought and shipped through Germany before the war, and believed to be German goods, are now known to be of American origin, and Russian importers are active in efforts to make permanent connections with such American exporters. In this connection it would be well if American manufacturers and dealers would mark all goods in some distinctive manner, as these goods are frequently confused with German goods even now, which may cause delays in the Custom houses. The Russian importer of American goods into this consular district is at present handicapped by shipping difficulties, uncertainty and high rate of exchange, and irregularities and delays in mail and cable service."

(*To be continued.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The A.E.G. Meeting.

I can quite understand that your correspondent, "Anti-Humbug," has excellent reasons for not disclosing his identity. He, however, is continuing to sling mud, and has now directed his fire more particularly in the direction of the electrical contractor. I therefore challenge him to come out into the open, and let us see if his name is as British as his sentiments, and if he is not better acquainted with the gas than the electrical industry.

His knowledge of the electrical contracting trade is certainly scanty. There are not 3,000 to 5,000 electrical contractors in the Kingdom. The E.C.A. represents the bulk of the important firms, and certainly two-thirds of the total capital invested in the business.

"Anti-Humbug" has purposely misread my letter. I did not say that the E.C.A. had had to deal drastically with its

members for trading with alien enemy firms; it is the question at issue which has received drastic treatment. I would suggest that your correspondent informs himself of the attitude of the Association in this matter by a study of the pages of the *Electrical Contractor* for the past sixteen months.

In my official position in the E.C.A., and during 25 years' contracting experience, I have naturally acquired a very wide and, I might add, valued acquaintance amongst electrical contractors, and I can say that I do not know of a single instance of any electrical contractor supporting alien enemy firms such as the Electrical Co. I do not know how these companies are being kept warm, but think it more than probable that the trade they do is with the fringe of the electrical industry, firms who do not quite know with whom they are dealing, such a one as I believe "Anti-Humbug" himself controls.

Your correspondent seems to suggest that any person engaged in this business who does not publicly disclaim trading with the enemy, is lacking in decency. I regret that I cannot follow this logic. Would it not be equally logical to expect honest men generally to publicly announce that they were not thieves?

H. Marryat.

London, E.C., *November 24th*, 1915.

The attention of my committee has been called to the correspondence under the above heading which has appeared during the past three or four weeks in your journal, especially to the letters appearing in the last issue signed by E. P. Allam & Co. and "Anti-Humbug."

With regard to the former, Messrs. E. P. Allam & Co. can hardly expect the E.C.A. to give full particulars in a public journal as to the action taken by the executive to deter members dealing with firms controlled by alien capital such as they mention, but I may corroborate the statement made by Mr. H. Marryat, that the executive of the Association have been very active in that respect.

I think I may safely say that the whole of the members of my Association are extremely averse to dealing with such companies, and I am instructed by the executive to accept "Anti-Humbug's" suggestion as to circularising the members in this issue.

If your correspondent "Anti-Humbug" will communicate with me directly, I will give him the assurance that I will not divulge his name to my executive, except with his permission, and I shall be prepared to act with him in preparing the circular letter to be sent to my members, and to inform him personally of the steps that we have already taken with regard to the matter of which he is complaining.

Leonard G. Tate, *Secretary,*
Electrical Contractors' Association (Inc.).

London, E.C., *November 24th*, 1915.

"Anti-Humbug" writes a very forceful letter, but, judging as a contractor of long experience, I am afraid he has not good experience. From his letters, I would say that his experience has been gained amongst the "cheap and nasty" type of electrical agents and contractors, who have in the past undoubtedly only been able to carry on business by buying and selling the very cheapest materials obtainable—usually foreign.

To class electrical contractors as a body, or even to suggest that the above class forms a majority of electrical contractors, is absurd. I do not speak for municipal engineers who have placed public orders for German plant, etc., as probably they will reply for themselves.

My firm is the oldest firm of electrical engineers and contractors in Great Britain, and I am glad to be able to say that they have never knowingly bought from German or Austrian manufacturers or their agents at any time. I believe that in buying the earlier forms of metallic-filament lamps and opal shades, say from any good British firm, such as Ediswan, Verity, G.E.C., etc., they have been indirectly helping German enterprise, but only because these articles were not obtainable elsewhere. I honestly believe that this is the position of nearly all of the electrical contracting firms of any importance.

There is no quarrel worse than a family quarrel, and for some years past, owing to the misdeeds of a few firms (usually firms of the here to-day and gone to-morrow type), our brethren in different branches of electrical engineering have been mud-slinging at electrical contractors as a body, and as represented by the E.C.A., both of England and Scotland. This usually has been done for a selfish purpose, but is it not time that this should stop? We are all, as classes, equally honourable business men, and it only keeps back the welfare of electrical enterprise to continue quarrelling amongst ourselves.

I am afraid, Mr. Editor, that this letter is a very general one, but I have been very sorry for a long time back to read and hear similar kinds of "authoritative" statements to that by "Anti-Humbug," and to know of the quarrels amongst the various classes of electrical workers. I always comfort myself by remembering what is nearly always correct, and that is that the real workers work on in unison, and it is the drones who make the noise.

Let us all do our work faithfully and honestly, leaving foreign goods alone, and it will be for the good of our country as well as ourselves.

Thos. B. Wright, A.M.I.E.E.
(Anderson & Munro, Ltd.)

Glasgow, *November 24th*, 1915.

Swiss or German?

The purport of your leaderette under the above heading in your last issue *re* the "Bank für Elektrische Unternehmungen," of Zurich (generally called "Electrobank") is not clear to anyone conversant with the actual facts. The Electrobank is a subsidiary of the Swiss Bankverein, of Zurich, and an international undertaking belonging to one of the great Continental rings for the development and financing of electrical undertakings all over the world, and well known to all engineers connected with pioneer work or the financing of large undertakings.

You may be sure that the Electrobank has no need or intention to "change its coat," as apparently your article seems to suggest, and any change made in its directorate has no bearing on the present war, but it is only natural that the Bank should wish to absorb in their directorate the best technical talent available, and that the seat which became vacant through the death of Emil Rathenau should be filled by Dr. Deutsch, who is one of the heads of the A.E.G. and—no matter what we may think of Germany as a nation—a capable man in electrical work.

I hold no brief for either the Electrobank or Dr. Deutsch, but I deplore any articles which may very well debar English manufacturers in the future from participation in international undertakings, which, as you are well aware, all large electrical undertakings must continue to remain.

A. M. H.

Brighton, *November 27th*, 1915.

[The object of the writer of the above letter is not as clear as it might be. The "actual fact" remains that whereas a year ago there were 19 German and seven Swiss directors, there are now 18 German and 14 Swiss. Does the writer suggest that a large number of additional Swiss directors, together with Dr. Deutsch, were required in order to repair the loss of technical talent suffered by the death of Emil Rathenau? "A.M.H." says that the changes have no bearing upon the present war. The directors in their report say: "Concessions had to be made to the *nationalistic* currents in the sense of occasioning the retirement of deserving administrators and officials from their positions" (Elec. Rev., October 29th, p. 576). The solicitude of our correspondent for the interests of English manufacturers as shown in his closing paragraph is quite pathetic. It would be interesting to know to what extent British electrical manufacturers have benefited in the past from the operations of such Continental banking organisations.—Eds. Elec. Rev.]

The Institution and Alien Enemy Members.

The correspondence under the above heading is indicative of the opinions of a considerable number of members of the I.E.E., and it is apparent that steps should be taken to remove from the list of membership those individuals tainted with the blood of our viperous enemies. A naturalisation paper will not change an individual's nature any more than a coat of wool will turn a lion into a lamb. It is merely a subterfuge.

If the members are united in their desires, why not petition the Council of the I.E.E. to take action? I strongly disagree with "Another Station Engineer" and his definition *irresponsible demigods*, as it is evident that the members combined can enforce their demands, providing they are united.

My own view is that the members of the I.E.E. should prepare their protest outside the Institution, and if they feel justified present it to the Council. I should be pleased to hear from any member sharing my views, with the object of taking speedy action.

W. Ellerd-Styles.

London, W., *November 29th*, 1915.

Decimal Coinage and the Metric System.

Mr. H. M. Sayers writes to point out that his letter in our last issue should read "2,000 salary and wages payments," not "£2,000" as printed. We regret the error.—Eds. Elec. Rev.

Birmingham Tramway Accident.—With reference to the accident which recently occurred on the Birmingham Corporation tramways, and was referred to on page 655 of a previous issue, the Electro-Mechanical Brake Co., Ltd., of West Bromwich, ask us to state that the car was not fitted with the "Maley" electro-mechanical rail brake, with which a large number of the Birmingham cars are equipped.

ELECTRICAL ACCIDENTS IN 1914.

The following is the Report to the Chief Inspector of Factories and Workshops, submitted by Mr. G. Scott Ram, H.M. Electrical Inspector of Factories :—

During the past year I have had considerable assistance from three of the Divisional Inspectors—Messrs. Topham, Evans and Lowe, in the North-Western, North-Eastern and Midland Divisions respectively—and various members of the district staff have also done much work, especially in the investigation of accidents. Mr. Evans reports that he has taken every opportunity of getting into touch with consulting engineers and contractors, so that all new work for which they are responsible may be put up, in the first instance, in accordance with the requirements of the Regulations. He points out, as does also Mr. Topham, that many contractors put in inferior apparatus and material, on account of cheapness, well knowing that it does not comply with the Regulations, being afraid that if they tender for work which will comply with the requirements, other contractors will not do so, and will get the orders on the question of price alone. The factory occupier eventually has to suffer, and is put to a greater expense in putting the matters in order than if he had paid for the proper material in the first instance. The obvious course for consulting engineers and for factory occupiers is to specify that the installation shall comply with the Regulations. If then it is found not to be in accordance with the requirements, the contractor can be called upon to put it in order at his own expense. The extra cost involved is becoming less important, as more manufacturers are making apparatus (*e.g.*, fuseboards, &c.) to comply, which is little, if any, more costly than the inferior and dangerous types which do not comply. Mr. Lowe finds that by repeated visits to different districts the local contractors are beginning to realise that bad work is liable to be found out and condemned, and are improving their standard accordingly. Both Mr. Evans and Mr. Lowe draw attention to the inefficiency of earth connections on most installations, and they enumerate many other dangerous conditions which they have found. Mr. Topham found some high-tension switchboards having passage-ways only 18 in. wide, and unprotected conductors all along one side. Mr. Shinner reports that in the case of an accident in a factory sub-station, where a workman of a Corporation electric supply department got on to some high-tension conductors, and was rescued by one of the factory employés, the Corporation showed their appreciation by presenting the rescuer with £10. Reports from other districts show that various defects in installations have been found and dealt with. Many inspectors refer to the continued increase in the use of electrical energy for power purposes. It is impossible to make an estimate of this increase for the past year, as I have generally done, as the usual returns from sources outside the department are not available.

Four prosecutions for breach of Regulations were taken during the year, and penalties of £5, £10 and £50 were imposed. One case was dismissed on technical (legal) grounds.

TABLE I.—Accidents at Electrical Generating Stations and Sub-Stations in 1914.

(The small figures relate to fatal accidents, and are included in the principal figures.)

Description.	Public supply stations and electric railways and tramways.	Other stations.
Non-electrical :—		
At engines, pumps and generators	36	11^{3}
At boilers and steam plant	76	1
At coal-handling plant	18^{1}	1
Falls	97^{2}	5
Struck by falling bodies	35^{3}	1
Miscellaneous	88^{1}	12
Total	350^{7}	31^{3}
Electrical :—		
At switchboards when engaged in ordinary routine work	19	7
Cleaning, repairing, &c., at "live" switchboards or other "live" conductors ...	29^{1}	20^{1}
Cleaning, repairing, or other handling of switchboards supposed to have been made "dead"	2^{1}	—
Adjusting brushes and cleaning commutators and flashing at commutators	2	4
Miscellaneous	13^{1}	3
Total	65^{3}	34^{1}

The mechanical accidents are fewer by 58 than in the previous year, a reduction of 13 per cent. They are such as are liable to occur in engineering works. A number were due to working on moving machinery. One, causing two deaths, was due to the bursting of a steel bottle of compressed air for starting a gas engine.

The number of electrical accidents is slightly larger—99 as against 94 in the previous year, with four fatalities as against three. Under the first heading of the table some of the accidents were due to mistakes on the part of the switchman ; others were due to matters beyond his control, either to faulty switch gear or to faults on the circuit at some distant point. In all cases the injuries were burns. In one the tank of an oil switch burst, and the attendant was injured by the burning oil. Six of the accidents occurred in the renewing of fuses.

One half of the total accidents in electrical stations occurred to men when working on live conductors—mostly on switchboards. Eight occurred on extra-high-tension systems, and three on high-tension systems. Two cases were fatal. One of these occurred in a consumer's sub-station to a man dusting a switch (5,000 volts) in a compartment with a door normally kept locked, but which he had himself opened. He was probably under the impression that the switch was dead, but the controlling switch in another compartment had been left "on." The other case occurred to a man working in an underground sub-station making contact with an inadequately protected temporary cable (2,400 volts). In most of the high-tension accidents the injured persons were doing work which was unauthorised and were themselves to blame. In one case an engineer attempted to do some work in a switch cubicle (10,000 volts). The switch was not in use, although live on one side, and it could have been made dead by means of the isolating switches provided for the purpose. This, however, involved the taking down of a heavy iron screen, and rather than take the trouble to do this he took the risk. This accident emphasises the desirability that such doors should be hinged or made to slide on runners so that they may be readily opened. One accident was caused through a short circuit to the framework of the switchboard by the metal end of the insulating pole provided for operating the isolating switches. One accident was due to the misunderstanding of a telephone message. Of the accidents on medium-pressure and low-pressure systems, 16 were caused by making short circuits with ordinary spanners, screw drivers or pliers. One accident was due to short circuit in attempting to remove the tank on a live oil switch. Two other fatal accidents under this heading were reported, but they are not included in the table as they did not occur on premises under the Act. One was in a switch-house on a 10,000-volt system, and the other at a transformer box in the street at 2,400 volts.

Under the next heading, the fatality occurred to an engineer-in-charge taking hold of live conductors of a high-tension arc lighting switchboard presumably thinking they were dead. A switch controlling the switchboard had apparently, contrary to the usual custom, been left on inadvertently from a previous shift. The victim was, no doubt, to some extent blameworthy in not ascertaining for himself whether the board was dead.

Under the miscellaneous accidents, the fatal case occurred to a man who touched with his head a neutral conductor of a high-tension alternator. Several alternators were running in parallel, the neutral point of one being definitely connected to earth. It had previously been assumed that the neutral points of the other machines would have been very nearly at earth potential. In this case it proved that there was 500 volts pressure to earth. The machines were of different types, and the one in question was of lower voltage than the others and connected through a step-up auto-transformer.

TABLE II.—Electrical Accidents In Factories other than Electrical Stations in 1914.

(The small figures relate to fatal accidents and are included in the principal figures.)

Arcing of switches	38
Arcing of fuses	9
Shock or burns when replacing fuse wires	22
Portable apparatus, connectors and flexible wires	65^{2}
Unprotected conductors, switches, terminals, fuses, &c. ...	39^{7}
Working on live electrical apparatus or conductors { skilled persons ...	42^{1}
{ unskilled persons..	46^{3}
Miscellaneous accidents in electrical manufacturing and repair works—mostly in testing operations	55^{1}
Adjusting brushes and cleaning commutators and flashing at commutators	6
Miscellaneous	31^{3*}
Total	350^{16}

* One fatality, fall following shock.

The electrical accidents in factories are fewer by 68, or 16 per cent., than in the previous year, the number of fatalities (16) being one less. The accidents in renewing fuses afford examples of the dangers of different types of fuses to which I have drawn attention in former reports. Most of the injuries are burns from short circuit, but some from shock. In some cases short circuits were made by getting the fuse wire or pliers or other tool across the terminals of both poles or between one pole and the metal case. In some instances the fuses had been protected by a switch, but being at a distance it was not used. In other cases where there was a switch at the fuses it was connected on the wrong side so that the fuse terminals were live whether the switch was "on" or "off." Several occurred with fuses in porcelain carriers having the fuse wire in a groove in the front of the porcelain. In these cases, the fuse having blown, the attendant replaced it without having investigated and rectified the fault which caused it to blow in the first instance, with the result that immediately the fuse-holder with the new fuse wire was put into contact, the fuse blew again, burning his hand. Others, causing shock, occurred with the "bobbin" or "grip" type carrier having live metal at each end of the porcelain. None of the above arrangements of fuses complies with the Regulations. Fuses not protected on the live side by switches should be of the switch-fuse type so constructed that the hand when grasping the handle cannot touch live metal, and is shielded from the arc should a fuse blow when being plugged in.

Of the accidents in the use of portable apparatus, 26 occurred in handling the flexible conductors. One case, having fatal results, occurred to a man when working on the wet floor of a dry dock. He was engaged in scraping a ship's bottom and is sup-

posed to have trodden on the flexible cable of a portable lamp cluster, a nail in his boot piercing the insulation of the cable. In many works there is no proper examination of the flexible conductors which remain in use after being badly damaged and worn out. In some cases the metallic armouring of the flexible wires had broken and pierced the insulation. Metallic armouring, especially in the form of a wire helix, is not a desirable form of protection. The earth connection is liable to become disconnected, and through rough usage and constant bending the wire is apt to break and pierce the insulation, and becoming live is very dangerous. Other forms of protection, such as rubber or hard cord braiding, are generally preferable. Twenty of the accidents occurred in connecting the flexible wires to the circuit. In six cases "adapters" were being put into lampholders and short circuits occurred. In other cases pin plugs of the old type were used, the wires short-circuiting at the point where they enter the plug. In most of these cases the use of safety type hand shield plugs would have prevented the accidents. The short circuits which occur in this way are often very heavy, leading to very severe burns, by reason of the circuit being too heavily fused. In one case it was found that the circuit for a hand-lamp was fused for 60 amperes. Three cases of shock occurred from unearthed portable drills. Some cases of shock from hand-lamps also occurred. One fatal case—also in a dry dock—occurred in the use of a portable "cargo lamp," a cluster of several lamps being mounted in a metal reflector. The whole fitting became live by reason of a terminal screw in one of the lamp-holders being in contact with the barrel of the holder. The man took hold of the reflector of the fitting and was killed. The fitting was not earthed, and was not in accordance with the requirements of the Regulations. It is noteworthy that safety type cargo fittings have been devised and are now on the market.

Under the next heading, "unprotected conductors," there were seven fatalities, of which six were due to contact with overhead wires. The wires, although out of reach from the ground, were so placed that workmen in the course of their duties might have at some time to get into close proximity to them. In one case, wires covered only with braiding were run out of doors close to a steam valve. A man had to get to the valve and came into contact with the wires (440-volt three-phase) and was killed. The braiding of wires without any insulating covering is quite useless, and may lead persons erroneously to suppose that they are insulated and safe to touch. The next case was similar; the bare wires, although out of reach from the ground were within reach from a pipe bridge on which the man got in the course of his duties. He made contact with the wires and fell to the ground, a distance of 11 ft., and although he died from the results of the fall, he was able to state that he received a shock. The next case occurred at a wharf where pit props were unloaded and stacked. The wires were 22 ft. from the ground, but the props were stacked in some places to within 3 ft. of the wires. The supply was 440 volts, three-phase. A man on one of the stacks touched the wires and was killed. The next case was also on a 440-volt, three-phase system. Bare wires were run under the roof of a large engineering shop. Men were at work painting the roof, and one of them took hold of the wires and was killed. His mate managed to hold him until assistance came and he was lowered to the ground. Another case was similar in all respects except that the system was 400 volts, three-phase. Two men tried to get the victim off the wires, but themselves received shocks, and he fell to the ground. In the other similar fatality, a man was sent to clean out a gutter, close to which were live wires at 500 volts, three-phase. The seventh fatal case occurred in an engineering works to a man touching the live parts of a 240-volt, three-phase switch which had no cover, and which he had to use. It was a throw-over type of switch, having double blades at right angles on each pole, so arranged that in grasping the handle the hand would be liable to touch the projecting blades of the outcoming side. Of the non-fatal accidents nine were in connection with electric cranes. Five were by men touching the bare trolley-wires when getting in or out of the cage. Four were due to unprotected conductors in the cage.

Under the next heading, "skilled persons working on live conductors," the fatality occurred on a 440-volt, three-phase system. Alterations had to be made to a motor circuit, and the electrician cut into a live wire with a pair of pliers. It was found that the fuses protecting the circuit had been removed from two of the wires, but not from the third. The accidents under this heading might for the most part have been avoided if the work had been done at night when the works were shut down. Several occurred at switchboards when tightening nuts with ordinary uninsulated spanners.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Half-Watt Lamp Fittings.

Messrs. Engineering and Arc Lamps, Ltd., of Sphere Works, St. Albans, Herts., have recently issued a list of half-watt lamp fittings covering practically all requirements for works office, street and shop lighting, indoors and out of doors. These fittings are substantially constructed, the cast-iron globe ring being hinged and held up by a fly nut; they are sent out with rigid internal connections and the minimum of wiring is required on erection. The fittings are thoroughly ventilated and designed to endure handling and all weather conditions. Internal cut-outs and substitutional resistances can be supplied if required.

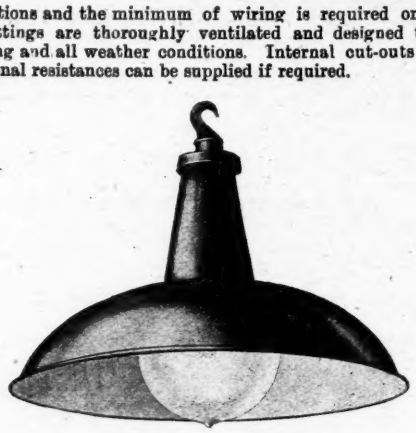


Fig. 1.—Britannia Fitting.

In several patterns hexagon lanterns are supplied as alternatives to globes, thus reducing replacement costs in case of breakages; a variety of glass also is available—opalescent, frosted, clear muranese or other pattern. We illustrate in figs. 1 to 3 the

Fig. 2.—Bristol Fitting.

Fig. 3.—Outside Shop Window Fitting.

Britannia fitting for works and yard lighting, the Bristol fitting which is specially designed for street, railway, dock or harbour lighting, and a shop window reflector fitting; the firm also supplies indirect lighting fittings for interior lighting by means of half-watt lamps, the chain-suspended reflectors being either polished aluminium or opalescent glass.

Inspection Lamp for Shell Work.

The inspection lamp illustrated in fig. 4 is made by Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham. Apart from its robust constructions, which makes it particularly suitable for the strenuous usage of a shell factory, it is provided with an

Fig. 4.—Shell Inspection Lamp.

earth wire. The lampholder is insulated from the body, and both holder and lamp cap are protected and cannot be touched by the operator so long as the guard is in position. The lamp shown, if used with an earthing plug, has the approval of the Home Office.

Combined Heater and Fan.

The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., have introduced a combined steam heater and electric fan for factory heating, which should prove useful for installation in the munitions workshops of which so many have been hastily erected and equipped. The device consists, for low-pressure steam, of a

battery of cast-iron gilled radiators enclosed in a strong sheet-steel casing, at the top of which is mounted an electric propeller fan; the latter blows air downwards through the heater and distributes it near the floor level. The heater is carried on a substantial cast-iron base and is fitted with steam connection and valve and drain pipe. A similar device is made for high-pressure steam, consisting of a battery of weldless steel tubes bent to U shape and expanded into the cast-iron header, with a sheet-steel casing and electric fan as before. The system appears to be very simple, efficient and easy to install.

Simple Battery Switching Scheme.

The switching scheme shown in the accompanying diagram is used in a power station where a 110-volt direct-current control circuit is needed for operating oil circuit-breakers. For this purpose a 275-cell power storage battery was available, the proper voltage being obtained by tapping off the required number of cells.

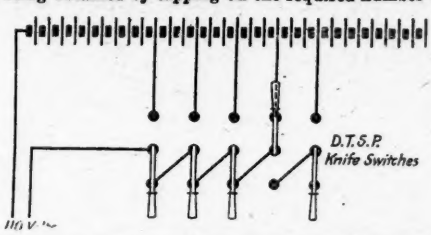


Fig. 5.—Knife Switches Wired for adding End Cells.

To take care of the changes in the voltage of the battery at different times of the day, taps were taken from five cells. The connections for changing from tap to tap are shown in the diagram, five single-pole, double-throw switches being used. The arrangement is practically foolproof, as it is impossible to short-circuit any of the cells in changing from one tap to another.—*Electrical World.*

Rust on Legs of Transmission Line Towers.

Each tower in a new transmission line between Prairie du Sac and Madison, Wis., is provided with renewable legs. Those portions of the legs most likely to be attacked by rust—the sections at the ground line—have been made renewable, so that any weak member

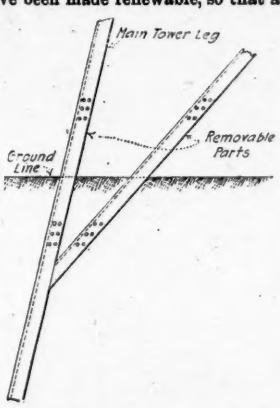


Fig. 6.—Renewable Parts for Tower Legs at Ground Line.

may be replaced. Under normal conditions any square-base tower will stand on three legs, so that to substitute new pieces in place of rusted ones the maintenance crew has only to unbolt the old ones, remove them, and put in duplicate members.—*Electrical World.*

A Novel Lamp Shade.

Messrs. Electra, Ltd., of New Barnet, N., have recently introduced a novel electric light shade which has been specially designed to enable the police regulations regarding reduced lighting to be easily and effectively complied with.

The shade can be opened on one side to throw light in a desired direction, giving a subdued light elsewhere, or it can be opened at the bottom for downward lighting. The material used is blue or green coloured, mounted on a wire frame to prevent the fabric from touching the lamp.

LEGAL.

Osram Lamp Works, Ltd., *v.* Pope's Electric Lamp Co., Ltd.

Mr. Walter, in replying on behalf of the appellants, contended that upon the evidence there had been clearly infringement by the respondents (defendants) of the plaintiffs' patent. He contended that Mr. Ballantyne's (a witness for the defence) evidence under cross-examination in the Court below really amounted to an admission of infringement by the defendants. He contended that the plaintiffs were clearly entitled to judgment on the issue of infringement.

The Master of the Rolls stated that the Court would take time to consider its judgment on the issue of infringement, and should it be thought desirable to hear further arguments on the other issues in the case, an intimation to that effect would be sent to the parties or their legal advisers.

Munitions Act Case.

At a sitting of the Oldham Munitions Tribunal last week, the interesting point was raised as to whether a junior cost clerk, aged 15, who was seeking his discharge certificate from a local firm of electrical engineers, was engaged on munitions. The youth had the chance of going into the cotton industry, and his father said his prospects would be much improved, but the firm he was now with refused to let him go. For the firm, it was stated that they were entirely engaged on munitions work, and that the youth had been employed about a year, and had taken the place of a man who had enlisted. After hearing both sides, Mr. Sellers (chairman) announced that he and his colleagues had come to the conclusion that a junior clerk of 15 years, even in the office of a controlled establishment, was not a person employed on munitions within the meaning of Sec. 7 of the Act, and therefore his application for a leaving certificate would be granted.

Inland Revenue Case: Appeal by the Underground Electric Railways Co. of London, Ltd.

In the Court of Appeal, before Lords Justices Swinfen Eady, Bankes and Warrington, on Monday, an appeal was heard by the Underground Electric Railways Co. of London, Ltd., and Glyn, Mills, Currie & Co., from a decision of Mr. Justice Scrutton, affirming a decision of the Commissioners of Inland Revenue.

The question in the case was what was the proper stamp duty to be assessed upon a deed dated December 13th, 1912, made between the appellant company and Glyn, Mills, Currie & Co., as the trustees, by which the company agreed, provided a sufficient number of the holders of ordinary stock of the Central London Railways Co. would take guaranteed stock in exchange for their ordinary stock, to guarantee interest at 4 per cent. on such guaranteed stock, payable half-yearly, if and to the extent that the profits of the Central London Railway Co. were not sufficient to pay that amount of interest. Mr. Justice Scrutton having affirmed the assessment of the Commissioners, the Railway Co. and the trustees of the deed now appealed to the Court of Appeal. Their Lordships dismissed the appeal with costs.

Restraint of Trade.—Messrs. Herbert Morris's Appeal.

In the House of Lords before Lords Atkinson, Shaw, Parker and Sumner, after arguments, lasting five days, judgment was reserved in an appeal by Herbert Morris, Ltd., from an order of the Court of Appeal affirming by a majority—Lord Justice Phillimore dissenting—a judgment of Mr. Justice Sargant in favour of the present respondent, Mr. Fred. Albert Saxelby.

Sir Robert Finlay, K.C., Mr. A. J. Walter, K.C., and Mr. D. M. Kerly, K.C., appeared for the appellant company; Mr. Mark Romer, K.C., and Mr. W. R. Sheldon for the respondent.

Sir Robert Finlay, in opening, said that the only point their Lordships were asked by this appeal to decide was whether or not an agreement under seal executed on March 17th, 1911, by the parties to these proceedings was a covenant unenforceable in law as being unreasonably in restraint of trade—that is, as being in wider terms than was reasonably necessary for the protection of the appellants in their business. The facts have already been fully reported in the Electrical Review.

The learned counsel went on to contend that the covenant was not wider than reasonably necessary for the protection of the appellants' business. He traversed the judgments of Mr. Justice Sargant and those of the two members of the Court of Appeal (the Master of the Rolls and Mr. Justice Joyce) who agreed with him. He asked the House to hold that the dissenting judgment of Lord Justice Phillimore was right, and that this appeal should be allowed. The case of employer and employé was not different in principle from that of vendor and purchaser, for the protection of property in each case was the foundation of the principle.

Mr. Mark Romer, K.C., for the respondent, submitted that the order appealed from was right. An employer was entitled to take a covenant from his servant which would prevent him disclosing trade secrets. But there was no secret trade here. An employer was not entitled to say: "I will teach you the business, but I will prevent you competing with me afterwards." It was not a case of prohibiting a servant soliciting orders from his former master's customers.

In the result, the House reserved its decision.

Wilkins *v.* Engineering Works, Ltd.

In the Lord Mayor's Court, on Friday, before the Recorder (Sir Forrest Fulton, K.C.), and a jury, a claim was made by John Wilkins & Co., general metal workers, of Clerkenwell, against the Engineering Works, Ltd., London, E.C., for £32 12s. 6d. damages for refusal by the defendants to accept the balance of an order for electric light enamelled iron reflectors. Mr. Kyffin was counsel for the plaintiffs, and Mr. Werninck for the defendants.

According to the plaintiffs' case the defendants appeared to have had a contract to fit up the electric light at the new buildings erected for the Pearl Insurance Co., in Holborn. The defendants required a cheap article made in the cheapest material. Such reflectors were usually made of copper, and a very good article could be turned out. The defendants wanted them made of iron,

to a special design, for which special tools and a special process were required. The reflectors were 2 ft. across, and the price of them was to be 5s. each. On July 30th, an order was given by the defendants for 1,000 enamelled pressed steel reflectors, the price with fittings to be 11s. each. Although the defendant pressed for the delivery to be made within a specified time the plaintiffs would not consent to such a term being made part of the contract, but undertook to do their best to make delivery within the time. From time to time complaints were made of certain of the reflectors as they were delivered, defendants complaining that they were not up to sample, and that the enamel was chipped. The plaintiffs, however, said that the articles delivered were commercially up to the sample, but any that were not they were agreeable to replace, and the enamel was not chipped when the reflectors were delivered. The defendants had in all taken 600 of the reflectors, which had been paid for, and it was in connection with the balance of 400, which the defendants refused to take, that the plaintiffs' were now seeking to charge simply the stampers' charges, which they had had to pay. In the negotiations which had taken place a Mr. Bauer, who had changed his name since August 4th last year to Mr. Bower, seemed to be the owner of the defendant business.

Mr. Werninck, for the defendants, said that Mr. Bower was the managing director of the defendant company; he was British born, and the shareholders were British subjects.

Mr. John Wilkins, senior partner in the plaintiff firm, was called, and gave evidence in support of the claim. He said that if the reflector which the defendants required had been plain, iron would have been a suitable material to have employed, and a more satisfactory job could have been turned out. The reflector required, however, was fluted, and for a fluted reflector copper was undoubtedly the better material. There was no doubt that an entirely different reflector to that which they had supplied was going to be substituted.

Counsel for the plaintiffs subsequently said that the parties had come to terms.

The Recorder thought it quite a satisfactory arrangement, and a juror was withdrawn.

Locker-Lampson *v.* Isaacs.

This matter was mentioned before Mr. Justice Sargant on November 26th, and the hearing of the motion was fixed for the first day in next sittings.

Alleged Infringement of Switch-Box Designs.

In the Chancery Division, Mr. Justice Younger had opened before him on Monday, November 29th, the action of Vandervell *v.* A. P. Lundberg & Sons, by which the plaintiff claimed relief in respect of an alleged infringement by the defendants of his registered designs for switch boxes used in connection with electrical installations.

Mr. Walter, K.C., and Mr. Hunter Gray were counsel for the plaintiff, and Mr. Colefax, K.C., and Mr. Eric Bousfield represented the defendants.

In opening the case, Mr. Walter said the action was for infringement of two registered designs, the first No. 562,949, registered in Class 3 on May 19th, 1910; the other was No. 568,527, registered in Class 3 on August 19th, 1909. The registration was under the Patent Act of 1907, Sec. 49 of which dealt with registered designs. This particular design applied to switch boxes for electrical installations, but the circumstances were different to those in a patent action. The whole question was whether a new and original design had been infringed, and that was really a question for the eye—the instructed eye. To the instructed eye two paramount things were in evidence, two tumblers and six switches in line mounted behind the plate. At the bottom there were two terminals which took off the current. He thought that the Court would have very little difficulty, having regard to the form in which these articles had been put upon the market, in coming to the conclusion that the defendants' switch-box was practically identical with the plaintiff's registered design. It was not until the end of 1913 that it came to the knowledge of the plaintiff that certain articles to which his design was applied were in the market. On those articles there was no name, and he could not for a long time find out who was putting them on the market. Finally a circular issued by the defendants came to his notice, and he discovered what they were doing. The defendants' articles had the switches arranged on the plate in the same way as the plaintiff's, two circles at the top in the same way, and the two terminals in the same place as the plaintiff's. A closer copy, he submitted, his Lordship could not conceive. Looking at a switch-box made in accordance with the plaintiff's design and one of the defendants, his Lordship would find them identical. The writ was issued on June 3rd, 1914, the plaintiff claiming an injunction, damages, and a delivery up of the infringing articles. The defence put in alleged that the plaintiff's design was not novel; that the defendants had not infringed it; and, further, that the plaintiff had used the number of his registered design upon articles that were not made in accordance with the design. With regard to the last part of the defence, in 1912 the plaintiff introduced two new forms of switch boxes. In one the registered number was on the plate, but in the other, no number appeared on the switch plate. That state of things remained until 1913 when, at the time of the Motor Show, the plaintiff introduced a new switch plate. It was got out in a hurry, and the new plate should have had on it no number; six plates, and six plates only, were produced, but by some mistake the registered number got upon one plate, and that plate was used in connection with a switch box not of the registered design. That one, and that one only, had the plaintiff been able to find, and immediately it was called to his attention he took the precaution of putting the registered number upon the wood of the switch box instead of on the plate. He submitted that the defendants had taken the substantial part of the plaintiff's design, and there was nothing whatever to deprive him of his legal rights under the Act.

Mr. Colefax said that one of his submissions would be that what was put in as an illustration of the plaintiff's switch box was not in fact the registered design.

Mr. Walter said the switch box produced was made from the design.

Mr. Colefax pointed out that it had no beading round it.

Mr. Walter agreed, but said he would produce another which had the beading. It made no difference. The defendants' was substantially produced from the plaintiff's design.

Albert Midgley, chief electrical engineer to the plaintiff, said they did a large business in supplying electric lighting installations for motor cars. It was in 1913 that it first came to his knowledge that switch boxes similar to their switch boxes were on the market. At the time they introduced the switch boxes of registered design there was not, to his knowledge, any switch box like them on the market. In 1911 the plaintiff introduced what might be called their No. 1 switch box, and on that the registered numbers appeared. Later, Nos. 2 and 3 were put on the market, but on neither of these appeared the registered numbers. The same switch plate was used in the latter as in the former. He never knew that the registered numbers had appeared on a No. 2 switch box until his attention was called to it after these proceedings were commenced. In January, 1914, he received a stock of new switch plates, all of which had on the registered number, but they were intended for the No. 1 switchboard. He could not explain how one got to be used for a No. 2.

Mr. Midgley described the process adopted by the plaintiff firm in constructing an article, and said that as soon as his attention was called to one of the switch boxes of unregistered design having gone out with the registered number on the plate he checked every one of the plates in stock. He had not now got any switch plates with the registered number upon them. The registered number was now stamped on the woodwork to avoid any possible error. There was no reason whatever for applying the registered design to switch box No. 2, and until his attention was called to the one instance adduced by the defendants he did not know that it had ever been done.

Mr. Geo. Croydon Marks said that he had had a lengthy experience of motors and motor accessories, and he knew of no switch box similar to the plaintiff's registered design.

For the defence, Mr. Colefax said that the protection afforded by a design was very meagre, and the Court would not assist the plaintiff to extend the protection he was entitled to. What was claimed here was a box with a sloping top and a plate in combination with a number of switches disposed in a line. He submitted that that was not the registered design at all. It was not right to pick out one or two features of the drawing and say they constituted the registered design. Everything shown in the drawing went to constitute the design as registered. Looked at in that way, the defendants' article did not infringe, and it was impossible to say that the metal plate was not an essential part of this design. In each of three respects the alleged infringement differed from the registered design. His second point was invalidity of the design.

Expert evidence was given as to the defendants' interpretation of the design, and

Mr. Walter, in reply, commented on the fact that the defendants had not given evidence as to how they came to get out their design.

At the conclusion of the arguments, his Lordship reserved judgment.

WAR ITEMS.

Necessary Trade Service.—The General Purposes Committee of the Manchester Chamber of Commerce has had under consideration the recent circular from the Board of Trade respecting the preparation by an Inter-Departmental Advisory Committee of lists of occupations from which enlistments ought to be restricted, in view of the necessity for maintaining the trade of the country as far as possible, and the following resolutions have been forwarded to the Reserved Occupations Committee:—

That, in the opinion of this committee, it is essential for the well-being of the country that the trade of the district should be kept in being as far as possible, in order (1) to provide the sinews of war; (2) to maintain exports and so counteract the serious decline in exchange which is the natural consequence of the increasing value of imports and decreasing value of exports.

That for these reasons it is essential that in certain occupations—subdivisions of the industrial and commercial community—a small percentage of men should be reserved from military service until the latest possible group, always taking into account the percentage of eligible men from that section who have already offered themselves for enlistment.

It is suggested that the undernoted classes of employés should be reserved to the latest possible group, on due representations to the Advisory Committee, viz., heads of departments, principal clerks, expert assistants, makers-up, packers, and case-makers.—"Manchester Courier."

Electricity Works Staffs and Recruiting.—Prior to the war the employés of the Carlisle electricity works numbered 50. Eighteen of these are already with the Forces, but the remainder, though starred men, are not content only to wear a war badge, and last week, leaving just sufficient of their number behind to keep the station running, they marched in a body (27), headed by Mr. Purse, the borough electrical engineer (who is himself of military age), to the recruiting office and presented themselves for attestation.

Up to the present 35 per cent. of the staff and employés of the Hull Corporation Electricity Department have enlisted. Mr. J. F. Magoris (deputy electrical engineer) has informed the Electricity Committee that, in view of the importance of the undertaking in regard to war purposes, he has not yet felt justified in sanctioning further enlistments under the old system. He now proposes that the Committee give their sanction to the remainder of the eligible members of the department offering themselves for enlistment under Lord Derby's scheme. The Committee in approving this course resolved that, in the event of any of those so enlisting being eventually called up to serve, they shall be recognised by the Committee on the same basis as those who have already enlisted.

Engineers and Munitions.—The Executive Committee of the Amalgamated Society of Engineers, in replying to the charges which Mr. Lloyd George made at the Trade Union Conference against certain trade unions, states:—"The best answer that can be given in reply to the general impression created in the public mind that the engineers have not loyally abided by the terms of the Treasury agreement is to state what the A.S.E. has done:—(1) The society has removed all overtime restrictions in regard to the production of war material, and did so in the early days of the war. (2) The society has adopted the Treasury agreement by a large vote of the members, and has loyally observed the terms of the agreement in regard to the non-stoppage of work and the settlement of disputes. (3) The society has agreed to the introduction of semi-skilled workmen doing skilled men's work, and unskilled and female labour doing semi-skilled men's work in the manufacture of shells and fuses."

German Shortage.—The "Morning Post" Paris correspondent says that in a statement issued to German troops on August 28th last, Colonel Oldershausen, Chief of Staff of the 8th Reserves, complains that some of the troops are careless in their collection of telephone wires, and he writes:—"All men must have it properly brought to their notice that, owing to the growing dearth of india-rubber, it is absolutely essential to take the utmost care of all insulated wires. All authorities possessing telephonic equipment, when it is a question of setting up a line or replacing one in use, should carefully determine their actual requirements and should remember that waste and faulty manipulation will one day make it impossible to furnish supplies. All troops should aim at making a reserve stock of wires by carefully collecting the old wires that are to be seen in every direction. The central administration is not in a position to supply all the requests for wire that are addressed to it."

The Only Real Safeguard.—The "Melbourne Age," for October 18th, says:—"Whilst the importation of enemy goods into the Commonwealth is prohibited by law, the Minister of Customs admits that very little check can be exercised regarding the introduction of enemy goods made in neutral countries. With a view to minimising trade of this class, the department is requiring that any goods which might be suspected of being of enemy origin must be accompanied by a certificate from the British Consul that they were manufactured in the neutral country from which they were exported. But the only real safeguard against helping the trade of the enemy, Mr. Tudor says, is for people to purchase the goods of their own country and those of undoubted British origin."

The Mark of Cain.—The "Morning Post" correspondent says that the three leading German Associations of Commercial Employés have just petitioned the German Chambers of Commerce, urging them to do everything possible to prevail on all employers of labour in Germany to guarantee that employés at the Front, whose positions are now filled by women, shall be guaranteed reinstatement after the war, and that the women concerned shall then be dismissed. The petitioners fear that a long time may elapse after the war before German men will be able to find employment abroad.

County Men with the Forces.—We have received from the County of London Electric Supply Co., Ltd., a copy of No. 2 of their "Staff War Bulletin." The Roll of Honour is re-published and is brought up to date, casualties, including those of four men killed in action, being indicated. A list of the wounded or invalided is given, and there are a number of general notes and seven pages of extracts from letters received from the Front.

Electrical Treatment for Wounded Soldiers.—Seven hundred wounded soldiers have arrived in Manchester for special electric massage, heat and light treatment, for which purpose the Corporation has set apart the art gallery and organ room at Heaton Park.—"Times."

BUSINESS NOTES.

Enemy Debts Notice.—By an order of the Chancery Division, an inquiry is to be made as to what debts of the enemy, Dr. Heinrich Traun & Söhne, to persons within the United Kingdom, not being enemies within the meaning of the Trading with the Enemy Amendment Act, 1914, remain unpaid. Any person claiming to be a creditor, and not being an enemy, is required to send particulars to the Public Trustee, the custodian under the Act, 3 and 4, Clement's Inn, Strand, W.C., or he will be peremptorily excluded from the benefit of the said order.

Bankruptcy Proceedings.—Saville & Walton, electrical engineers and contractors, 39, Victoria Street, Westminster, S.W.—The first meeting of creditors was held last week, at the London Bankruptcy Court, under a receiving order made in this case. Mr. Egerton S. Grey, Official Receiver, reported that Capt. L. A. Thomson had attended under the proceedings, and had stated that in May, 1911, he commenced business in partnership with another as electrical engineers and contractors, at the above address. They contracted for complete installations of electric light and power in works and private houses, also for sundry wiring work. They secured some fairly large contracts, and did very well. The partnership was dissolved in October, 1913, under terms that the debtor paid his partner £86, and continued the business alone. He was successful during the next few months, but the business then fell away, and when war was declared he lost several promised contracts, owing to the firms with whom they would have been made retrenching during the war. On September 18th, 1914, the debtor received a commission, and thereupon delegated the management of his business to another, and had only attended at the office on two occasions since he joined the Army. The business gradually declined, and in June last the debtor decided to close it until he would again be able to give it his personal supervision. He attributed his failure to competition, loss on contracts, outbreak of hostilities, and lack of capital. The liabilities were, roughly, estimated at between £2,000 and £3,000, and the assets were valued at £134. In the absence of any offer, the case was left in the hands of the Official Receiver to be wound up in bankruptcy.

Albert Whiteley, electrical and mechanical engineer, 7, Margaret's Road, Llandudno Junction.—Trustee (L. Hugh-Jones, Chester) released October 14th.

G. E. Hipkins, electrical engineer, Dudley.—Trustee (A. M. Fairbairn) released October 14th.

Catalogues and Lists.—Messrs. A. P. Lundberg and Sons, 477 and 489, Liverpool Road, London, N.—The firm has issued a bound catalogue (No. 1) of nearly 90 pages, in which there are exhaustively particularised only four of their many types of tumbler and other small switches, namely, single-way, "Twinob," double-pole and triple-pole. Prices of two-way switches are also indicated. Many of their plug connections, ceiling roses, &c., will be dealt with in future lists, but until the issue of these the old pamphlets are still available. The list contains about 200 illustrations, and in the main it deals with 30 different kinds and forms of single-way switch and modifications thereof. The contents are very neatly arranged, prices are clearly shown, and dimensions are given in both inches and millimetres. Copies of the catalogue are to be sent to the firm's regular customers, and other applicants will be supplied if a business card is forwarded.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—8-page leaflet giving full and illustrated description of the "Migas" detector for detecting the presence of gas in mines; also a four-page leaflet describing their combined steam heater and electric propeller fan system for factory heating.

Messrs. Pope's Electric Lamp Co., Ltd., Hythe Road, Willesden, N.W.—New leaflet giving prices of Pope's carbon-filament lamps. Trade customers can have quantities of the list over-printed.

Messrs. Brook, Hirst & Co., Ltd., Northgate Electrical Works, Chester.—Catalogue No. 3 is an excellent and convenient production of 136 pages in which the firm set forth very fully in tabular form prices, dimensions, code-words, and other particulars of their "Brookhirst" direct-current motor-starting and control gear. A number of further catalogues dealing with motor starters, control panels, and other lines, are in course of preparation. The publication now before us covers Midget starters and panels, overload trips for "B" and "C" type starters and panels, constant and variable speed standard "B" and "C" type panels, shunt regulators, multiple lever-type starters and panels, &c.

A New Zealand Exhibition.—The Commercial Intelligence Branch of the Board of Trade is notified by his Majesty's Trade Commissioner for New Zealand (Mr. W. G. Wickham) that the Wellington Chamber of Commerce are organising an exhibition of goods of British manufacture, to be held during one week in February next. Mr. Wickham suggests that British firms who are unable to supply the New Zealand market at the present time, either at all or on the same terms as previously, should endeavour to keep their names before the public, not only by participating in the exhibition, but also by carrying out a campaign in the local Press, telling the public, who are inclined to be sympathetic, exactly why their goods are not obtainable, or why they are higher in price. His Majesty's Trade Commissioner states that there is a marked tendency on the part of local agents to look to foreign countries as a source of supply.

British Trade in China.—In the course of an address to the Far Eastern Section of the London Chamber of Commerce and the China Association, Mr. Thomas M. Ainscough, the Special Commissioner of the Board of Trade, said there had been a growing conviction among British engineers for some time that unless the present system of representation in China was revised they would find themselves completely excluded from the electrical and industrial machinery market, which was being secured by the Germans. This conviction had been reflected in the formation of groups of British manufacturers, who had continued either to carry out their own pioneering work in China, in conjunction with the merchants, or to sell their products direct to Chinese. Such groups were working in the right direction, and their energy and enterprise deserved all success. The past 10 years had seen a wonderful increase in the number of European firms who were distributing their goods direct to the Chinese consumer in all the large towns of the interior through the medium of guaranteed Chinese agents, working under the constant supervision of European inspectors. In order to carry out a system of this kind we required powerful syndicates with large capital, and the ability to count the success of the system by carrying it out for at least a full trade cycle of five years or so. He emphasised the necessity for closer co-operation between the manufacturers and merchants in this country, the need for the provision of greater facilities from our banks and financial institutions for the purpose of financing deferred payments on large Chinese Government and private contracts for plant, machinery, and other supplies, and the importance in the future, as China opened up, for our mercantile assistants and travellers to secure a wider knowledge of the country and its people, their language, traits of character, business methods, and mode of life. British merchant houses in China, he said, ought to take advantage in the temporary lull in German competition in China during the war to revise their methods and put their house in order. The openings for an extension of the foreign trade of the country were greater than ever before.—*Daily Telegraph.*

U.S. Electrical Exports in August.—The *American Electrical Review* quotes the following facts regarding the electrical exports during August. Although the electrical total is below that of July, it exceeds that of August, 1914, by nearly 80 per cent. The latter month, however, was the first month of the European war when all international commerce was very seriously curtailed. For the four classes for which the number of articles exported is given in the Government report, there were shipped last August the following:—Electric fans, 1,112; arc lamps, 75; carbon-filament lamps, 140,282; metal-filament lamps, 461,580.

The detailed figures for the electrical classes reported are:—

	August, 1915.	August, 1914.
Batteries	$114,516	$38,722
Dynamos or generators ...	216,906	114,570
Fans	15,453	5,528
Insulated wire and cables...	251,083	51,236
Interior wiring supplies, &c. (including fixtures) ...	49,202	43,511
Lamps—		
Arc	1,633	1,620
Carbon-filament	17,221	4,338
Metal-filament	74,119	9,592
Meters and other measuring instruments	57,244	23,747
Motors	277,940	118,490
Telegraph instruments (including wireless apparatus)	17,030	3,101
Telephones	50,841	78 403
Transformers	29,146	33,609
All other	633,958	497,543
Total... ...	$1,806,292	$1,024,010

The total value of all electrical exports for the first eight months of 1915 was $14,977,440, compared with $13,654,569 during the corresponding months of 1914, and $18,949,235 for 1913.

Dissolutions and Liquidations.—Brighten, Malcolm and King, Ltd.—A meeting is called for December 29th, at 16, Philpot Lane, E.C., to hear an account of the winding up from the liquidator.

P. L. Dwyer & Co., electrical manufacturers and suppliers, 66, Victoria Street, London, S.W.—Messrs. P. L. Dwyer & P. R. Winterson have dissolved partnership. Mr. Dwyer attends to debts, &c., and continues the business under the same style.

Stolz Electrophone Co. (1913), Ltd.—December 15th is the last day for the receipt of proofs for dividend, by the liquidator, Mr. H. E. Burgess, 33, Carey Street, W.C.

Holborn Electric Fires, Ltd.—This company is winding up voluntarily, with Mr. W. G. Parratt, 163, Harringay Road, West Green, as liquidator.

Trade Announcements.—Messrs. William Sanders and Co., of Falcon Electrical Works, Ridding Lane, Wednesbury, writing to us with reference to a recent registration of a company named "Wm. Sanders & Co., 1915, Ltd.," desire it to be known that this has no connection with themselves, as their firm is, and always has been, a private one.

For family reasons, the business of Messrs. McKechnie Bros, copper smelters, &c., of Birmingham, has been converted into a private limited company as McKechnie Brothers, Ltd. The general management will remain as heretofore.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIV, No. 11. November, 1915. New York: The Institute.

"Examples in Alternating Currents." Vol. I. By Prof. F. E. Austin. Hanover, N.H., U.S.A.: F. E. Austin. Price $2.40.

"Science Abstracts," A and B. Vol. XVIII. Part 2. November 25th, 1915. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each.

"*Journal* of the Institution of Electrical Engineers." Vol. LIV, No. 251. London: E. & F. N. Spon, Ltd. Price 3s. 6d. The issue for December contains the following papers:—"A New High-Efficiency Incandescent Lamp," by E. A. Gimingham and S. R. Mullard; "The Higher Harmonics in Oscillograms," by Prof. G. W. O. Howe; "A Mode of Studying Damped Oscillations," by Prof. D. Robertson; "The Magnetic Testing of Bars of Straight or Curved Form," by A. Campbell and D. W. Dye; "Armature Copper Losses in Rotary Converters and Double-Current Generators," by L. H. A. Carr; "The Production and Properties of Electrolytic Copper," by B. Welbourn; and the Inaugural Addresses of the President, Mr. C. P. Sparks, and Messrs. D. A. Starr, D. E. Roberts, and W. L. Carter.

Fire.—A fire occurred on Saturday at the premises of Messrs. Howell & Co., electrical engineers, of Lichfield Street, Hanley. Part of the premises was gutted, and the damage done is estimated at between £2,000 and £3,000.

For Sale.—The Leeds Corporation Tramways Committee has for disposal six Lancashire boilers, with mechanical stokers, superheaters, &c. The Manchester Ship Canal Co. has for disposal two Lancashire boilers, one set of triple-expansion vertical condensing engines, four pneumatic pumps, and 440 ft. of pipe. Particulars are given in our advertisement pages to-day.

A German Trust.—The Central News says that "An Electrical Works Trust has been established in Berlin, to which the greater number of the big companies belong." Absence of fuller information leaves us in doubt as to whether this indicates any alteration in a state of affairs that has long existed.

Board of Trade Inquiries.—South Africa.—A Johannesburg agent wishes to obtain agencies of United Kingdom manufacturers of electrical fittings, wire, and sundries. Manufacturers can obtain his name and address by applying to the Board of Trade Commercial Intelligence Branch, 73, Basinghall Street, E.C.

Electric Lamp Renewals.—The method employed by the Allies Electric Lamp Co., Ltd., of Montgomery St., Hammersmith, W., for repairing electric lamps, is to cut the bulb just below the shoulder, renewing the hooks and filament, and welding the glass together again.

New Lamp Factory in Spain.—It is reported that a new factory for the manufacture of metal-filament incandescent lamps is about to be established in Madrid.

LIGHTING AND POWER NOTES.

Atherton.—Price Increase.—The charges for electrical energy for power, heating and cooking purposes are to be increased from January 1st as follows:—To consumers purchasing energy at a price not exceeding ·625d. per unit, 20 per cent.; to consumers purchasing energy at a price above ·625d. per unit, 10 per cent.

Australia.—The Williamstown T.C. (Vic.) is borrowing £20,000 for the installation of electric light and for drainage purposes.

The Blue Mountains (N.S.W.) Council proposes borrowing £25,000 to install electric light in the towns of Lawson, Blackheath, Springwood, Mount Victoria, and Medlow.

The Queensland Government has appointed Mr. W. Corrin, chief electrical engineer of the New South Wales public works department, to prepare a scheme for the establishment of an electric power station at Ipswich, to supply power and light for Ipswich and Brisbane and the neighbouring localities. It is expected that the Government and the railway department will co-operate in the carrying out of the scheme.

The Wangarratta (Vic.) Council has applied for an order in Council for the supply of electric lighting.; the Kyneton (Vic.) Council has also applied for an order to install electric light at Trentham.—*Tenders.*

The Melbourne City Council has had under consideration a resolution, the object of which is to encourage the installation of electric lighting and heating and power in city buildings, thereby increasing the business of the Council's electric supply department, and is to the effect that the initial cost of installing electric current in any premises within the city should be advanced by the Council, if and when desired by any owner, such owner to guarantee repayment in 30 monthly instalments, bearing interest, and that steps be taken to give effect to this. It is stated that only 25 per cent. of the buildings in the city are equipped with the electric light, the main reason being that the owners or lessees are not prepared to scrap their gas fittings and incur an immediate expense ranging from £30 or £40 upwards. The matter was referred to the E&L. Committee for report.—*Melbourne Age.*

Belfast.—Owing to the Treasury having refused to sanction the raising of loans by the Corporation for the purpose of providing electric service mains and meters to consumers, no further applications for electricity, involving this class of expenditure, can be acceded to.

Bispham.—Street Lighting.—The U.D.C. has agreed upon a modified scheme of electric lighting for the district, the electrical engineer having received the necessary instructions.

Bungay.—E.L. Scheme.—The U.D.C. has appointed a Committee to meet Mr. Best, of Bradford, with respect to an E.L. scheme for the district submitted by him. The clerk has obtained information from places where Mr. Best has carried out schemes.

Carmarthen.—The T.C. has considered an application from the Carmarthen Electric Supply Co., Ltd., for consent to increase the price of current to all customers by 10 per cent., owing to the increased cost of labour, &c. The company entered, five years ago, into a 14 years' contract for public lighting, and a clause stipulated that the charge to private consumers should not exceed 5d. per unit. The application was refused.

Dublin.—Sub-Station Explosion.—A violent explosion occurred on Saturday morning at the Corporation electricity sub-station at the corner of Forbes Street and Sir John Rogerson's Quay, which resulted in blowing out all four side walls, although these were 2½ ft. thick. The oil tanks and switches were enveloped in flames, which were extinguished by the fire brigade. Although the cause of the explosion is unknown, it is conjectured that it may have arisen from accumulated gas or benzole, the gasworks being close by.

Edinburgh.—The Electric Lighting Committee of the T.C. reports that the total applications for supply for the year, from May 15th, number 53,251 equivalent 8-c p. lamps.

The Committee has had under consideration the question of enlistment of men, in connection with the steps to be taken before the Recruiting Tribunal to get men exempted who are considered indispensable to carry on the undertaking. It was pointed out that men required to get themselves attested as a preliminary to their application for exemption, and the engineer was instructed to lay the matter before the men of enlistable age.

Gravesend.—Year's Working.—The report of Mr. McInnes, the borough electrical engineer, on the last completed year of working of the Corporation electricity undertaking, shows that 2,114,056 units were generated, and 1,570,895 sold (as against 1,441,482 in the previous year); of this amount 345,327 units were supplied to Northfleet and 342,775 units to the Gravesend and Northfleet Tramways Co. In view of the demands of large factories in the district, the power station equipment has been increased by the addition of a 1,000-kw., 6,600-volt, 50-cycle turbo-alternator, motor converters, and the necessary switchgear, &c., and H.T. feeders have been laid to the Rosherville sub-station, where a motor converter has also been installed. Before long a supply will probably be given in Swanscombe and Denton. Despite the effect of the restricted lighting orders, the engineer remarks that the output in September, 1915, was very considerably in excess of pre-war figures. The result of the year's working at Gravesend was a surplus of £827, which was transferred to capital account, while the Northfleet undertaking also realised a small surplus on the year.

Liverpool.—Price Increase.—The Electricity Committee proposes, owing to the increased cost of fuel, to increase the charges for electricity for lighting, power and other purposes by 12½ per cent., except in certain special cases.

London. — Hackney. — Linking-up Scheme. — The Electricity Committee recommends that, subject to the Poplar B.C. agreeing to the terms, and to the approval of the B. of T. being obtained, steps be at once taken to proceed with the linking-up of the Council's electricity undertaking with that of the Poplar Council, and that the necessary mains and switchgear be provided, at an estimated cost of £3,000; also that an additional E.H.T. switch panel should be erected with the three now in hand, at a cost of £417. This will enable the old engine room to receive the proposed supply when required, and the undertaking will be provided with a complete spare panel, which could be used for any other purpose in emergency.

Manchester.—Condensing Water Project. — The Corporation Rivers Committee has forwarded to the Finance Committee a recommendation for the expenditure of a sum of about £50,000 on the provision of tanks at the Davyhulme sewage works, in connection with the scheme for providing cooling water for the purposes of the electricity department.

Mutford and Lothingland.—Overhead Mains.—The Oulton Broad Electricity Co., Ltd., has asked the R.D.C. to sanction the erection of overhead mains, and also to sanction any further extensions that it might be found desirable to execute within the Council's area from time to time. The Council has agreed to the mains, but has declined to sanction any further undefined extension.

New Zealand.—In November last year, the Lake Coleridge hydro-electric scheme was formally opened, but it was not until March of this year that the service came into full continuous operation; since then the plant has worked smoothly and efficiently without serious interruption, and it is stated that the undertaking shows every promise of becoming a financial as well as an engineering success. The three units of generating plant now installed equal 6,000 H.P.; and the present demand, added to that in prospect, for which contracts have already been arranged, calls for the immediate installation of a fourth unit of 2,000 H.P., and there are indications that two further units of generating plant will have to be provided in the not distant future. The tunnel and headworks are sufficient to provide for probable expansion during the next six or seven years, when it is expected that the output will adequately supply the district which can be economically served from the Lake Coleridge scheme. The existing pipe-lines are of sufficient capacity to drive the fourth unit of machinery now on order, and the power house can accommodate this unit without additions. The total expenditure on this scheme from its inception to March 31st last was £262,034, and the installation of the fourth unit is expected to place the business on a footing where interest on capital, maintenance, depreciation, and working expenses will all be defrayed out of revenue. —*Otago Witness.*

E.L. Purchase.—The Timaru Council has decided to purchase from Messrs. Scott Bros. the electric lighting and power plant which supplies the town, and is obtaining a loan of £50,000 to complete the purchase and make necessary additions.

Portaferry (Co. Down).—Messrs. T. Somerville and Co., who supply electric light to the town, are charging only 6d. per week per light to tenants of small houses and labourers' cottages, the installations being made free of charge.

Rotherham.—The R.D.C. has consented to the erection of an overhead transmission line by the Corton Wood Colliery Co. from Brampton Bierlow to Wentworth.

Scottish Power Proposal.—It is proposed to utilise the water power of Loch Awe in the Scottish Highlands to secure electric power for steel works to be established in that district. Immediate steps are being taken to obtain a provisional order with this object in view. Loch Awe extends to 14½ square miles, with a catchment area of 300 square miles. The works will embrace a dam across the River Awe; an open canal, and steel pipes will lead the necessary water to the power house. The energy generated is to be transmitted by overhead lines to the site of the proposed works at North Connel. The cables cross Loch Etive, near Island Ferry, and follow a course along the hillside. The level of Loch Awe will be very considerably raised. At the new steel works at Loch Connel, where the process will be entirely electrical, there is both sea and rail communication. The chairman of the new company is Mr. J. Campbell Robertson.

Shipley.—Financial Result.—For the year ended March 31st last there was a loss of £404 on the electricity undertaking. This has been met out of reserve, leaving a balance of £719 to carry forward.

Stalybridge. — Price Increase.—The Generating Station Committee of the Joint Board has passed a resolution to the effect that all power consumers paying less than 1d. per unit be charged an additional 0·1d. per unit to cover the extra cost of coal, instead of the additional 10 per cent. charged at present. The alteration will take effect at the beginning of the New Year. The Committee has also decided that it cannot take on any additional large power consumers.

Stoke-on-Trent.—The Finance Committee of the T.C. has expressed the opinion that in the event of the additions at the Burslem Works being essential, the cost should be charged to the revenue account, and not to the capital account, as suggested by the Electricity Supply Committee.

TRAMWAY and RAILWAY NOTES.

Blackpool.—War Bonus.—The Corporation employés have accepted the terms offered by the Sub-Committee, *i.e.*, a war bonus of 2s. to those earning up to 30s., and 1s. for from 30s. to 35s. weekly, overtime not being taken into account.

The Tramways Committee has decided to curtail the night service. The total receipts from the beginning of the financial year (April 1st) to November 18th, on the Blackpool system, were £64,925, or £1,449 more than at the corresponding date last year. Considering there has been a decrease of nearly 29,000 miles in the aggregate car-mileage, the receipts are regarded as satisfactory.

From a report of Mr. Chas. Furness, the tramway manager, on the question of contracts, it appears there are only two other places in the country where tramway contracts are obtainable—Aberdeen and Lancaster. At Lancaster there are 232 contractors, and there is an annual loss to the tramways of nearly £2,000 a year. At Aberdeen there are about 1,000 contractors, paying an average of £3 4s. per annum each, against 1,466 contract-holders at Blackpool paying an average of £2 17s. each. In the Scotch town the sectional contracts are £2 10s. for the first 700 yards, and 2s. per annum for every additional 100 yards. Thus for £3 (the old contract rate for Blackpool) Aberdeen people could only travel on a 1,200 yards' section, while £6 1s. a year is charged for a length equivalent to Blackpool's Promenade.

Bradford.—Female Labour.—A special meeting of the Tramways Committee has considered a report of Mr. C. J. Spencer, the general manager, with regard to the effect of recruiting and the shortage of labour on the tramway system. Mr. Spencer reported that the present staff of 1,281 employés was absolutely necessary to maintain the present services; of that total 818 were of military age, and 151 were unmarried. He also referred to the difficulties experienced in replacing labour by men of non-military age. He considered that the peculiar conditions of Bradford were against the employment of female conductors, and that females as drivers were out of the question. The only alternative he could suggest was the one of very greatly curtailing the services. After discussing the report, the Committee decided that it was not desirable to employ women as conductors owing to the conditions existing in Bradford, and instructed the manager to draw up a report on the question of employing men who were unfit for military service, and also to consider a system of issuing tickets for the public to avoid the collection of fares on the cars.—*Leeds Mercury.*

Colne.—War Bonus.—The Council has considered a request from the Association of Tramway Workers for an advance in wages of 15 per cent., and has decided to offer an advance of 5 per cent. as a war bonus, to commence on January 1st and to cease 13 weeks from the declaration of peace.

Continental.—Spain.—Plans are being prepared in respect of a projected electric tramway in the town of Tortosa.

Dundee.—In asking for licences for a number of car conductors, the tramway manager stated that within a few days 41 men had left; he also pointed out that new men were resigning because they would not stand the criticisms of the townspeople, who apparently make no allowance for the lack of training of the new men, although the latter are temporarily filling the places of men required at the Front.

Edinburgh.—The Tramways Committee has decided to call the attention of the directors of the Tramway Co. to the frequency of the breakdowns on the system.

It is reported that the Tramway Co. has agreed to state a price at which it would be willing to sell the rolling stock, &c., to the Corporation, in view of the latter taking over the system on the expiration of the lease in June, 1919. Whatever the decision in regard to conversion to electrical working, the Corporation will require to work the present cable system for a time, and at June, 1919, there will still be a debt on the latter of over £300,000.

London.—The electric train service of the L.B. & S.C.R. was very much disorganised on Monday, owing to the derailment of an electric train at London Bridge Station.

Manchester.—The war bonus of 2s. paid to men guards is to be paid to women guards after three months' satisfactory service. Up to November 23rd, 2,107 men from the tramway department had joined the Colours, and payments made to them or their dependents are at the rate of £72,000 per annum. It is estimated that if all the available single and married men of military age employed by the tramway department join the Colours the cost to the department will be well over £100,000 per annum. The Tramways Committee has decided that men in the service of the department desiring to enlist must do so under the "group" system. The Treasury has sanctioned expenditure by the Tramways Committee on street improvement and the doubling of short lengths of tramways.

Northenden.—The Parish Council was informed last week that the Manchester Corporation had applied to the B. of T. for an extension of time to August, 1917, for the completion of the tramways and the compulsory purchase of land for street widening.

Normanton.—Tramway Track Maintenance.—At a joint meeting of representatives of the Councils of Normanton, Whitwood, Glass Houghton and Pontefract, it was decided to make representations to the B. of T. with regard to the condition of the tramway track between Normanton and Pontefract.

Reading. — Female Labour. — Women are now employed as conductors and inspectors on the Corporation tramways.

Salford.—The Tramways Committee has decided as an experiment, to allow a limited number of the wounded soldiers to travel free on the cars, for one month. This period, if the privilege is appreciated, will probably be extended. Other tramway Committees in South-East Lancashire have under consideration the granting of similar privileges.

South-Western Railway Electrification.—The proposed electric service on the Kingston "roundabout" line has been again postponed owing to an application to the Court by the Postmaster-General on Saturday, in connection with alleged interference with the telephone circuits in the neighbourhood of one of the sections which has recently been electrified. It is hoped that the service will be running before the end of the year.

Sunderland.—Female Labour.—The employment of female ticket inspectors on the Corporation tramways has been commenced.

Swansea.—Tramway Extensions.—The T.C. has applied to the B. of T. for an extension of time to February 28th, 1917, for the compulsory purchase of land required for tramway extensions.

TELEGRAPH and TELEPHONE NOTES.

A Swedish Telautograph.—A new telautograph, or telewriter, an instrument for the telegraphic transmission of ordinary handwriting, has just been invented by two Swedish engineers. The apparatus differs entirely from the fundamental principles of other telautographs. The most characteristic feature of the apparatus seems to be that it can be used independently of the electrical resistance of the line. It can be connected alternately to a long or short line without any adjustment of the resistance, and used in connection with public telephone systems.—*T. and T. Age.*

Australia.—The Federal Public Works Committee has considered the expenditure of £114,000 on an automatic telephone exchange for Sydney.

Automatic Telephony in Chicago.—Mr. K. B. Miller, the well-known telephone authority, who was authorised by the Chicago City Council to investigate the automatic telephone situation in that city, states that the problem resolves itself into a choice between two courses:

(*a*) To take the property for forfeiture and dispose of it for cash;

(*b*) To permit the sale of the property to the American Telephone and Telegraph Co.

Mr. Miller concludes that any attempt to continue the operation of the automatic system as a competing enterprise, either under city or private control, and either with or without interconnection with the system of the Chicago Telephone Co., will not be conducive to better or cheaper telephone service in Chicago. It will tend to lower the possible standard of service, raise the cost of service, and will, in all probability, cause the loss of large sums of money, failing for lack of public support.—*T. and T. Age.*

The Council decided to sequestrate the property some months ago because the company had not 20,000 *bonâ fide* subscribers, as required by its franchise.

Brighton.—Former users of the municipal telephone system have hitherto been allowed to retain their unlimited service at the old price (£5 10s.), whereas others had to pay £10 a year. Under the War Budget increases, the Post Office proposes to charge all unlimited-service subscribers £12, and the Brighton and Hove Telephone Advisory Committee is sending a deputation, in conjunction with Glasgow and Portsmouth, which are similarly affected, to wait upon the Postmaster-General with a view to securing better terms. Users of private telephones, over which no business is transacted, can retain them at £8 a year, and the measured-rate service is also available.

Code Telegrams.—The existence of another secret code in "plain language" was brought to light in the Glasgow Sheriff Court on Monday, when the proprietors and editor of the Glasgow *Daily Record and Mail* were charged with the possession of a cipher code not intended and used solely for commercial or other legitimate purposes. The code was to be used to place the *Record* in possession of information earlier than the news could be transmitted at Press rates.

Hull.—The Corporation telephone employés have sent in a petition for a weekly war bonus on the same terms as those granted to Post Office employés. They demand that the increased bonus shall be paid within seven days, and that it shall date from last March. The Corporation, in granting a 2s. bonus to all departments, included the telephone employés, but this bonus is 1s. less than that granted by the Government. A large proportion of the Corporation telephone staff was taken over from the Post Office, and they declare that they mean to enforce the demand for the extra shilling.—*Standard.*

The World's Wireless Stations.—The International Telegraph Bureau of Berne recently published statistics in relation to the situation of wireless telegraphy throughout the world on April 1st, 1915. According to the figures, the first position in the case of coast stations is occupied by the United States with 140 stations; the second place is held by Great Britain with 61; Canada ranks third with 47; Italy fourth with 37, and Russia fifth with 32; Alaska has 29; Brazil, 28; Spain, 21; Australia, 20; France and Germany, 18 each; Japan, 11; Austria-Hungary, 4; and China, 3 coast stations. As, however, the principal importance of wireless telegraphy relates to intercommunication between ships and between vessels and coast stations, the position of affairs assumes a different aspect as regards the ship installations of individual countries. On this point, the statistics give the following figures for the countries mentioned:—

Number of Ship Installations.

Great Britain	1,568	Austria-Hungary ...	101
United States	967	Japan	96
Germany	537	Brazil	65
France	357	Spain	79
Italy	125	Australia	64
Holland (6 coast stations)	122	Norway (6 coast stations)	85
Russia	119	Argentina (12 „ „)	83

The statistics show a total of 706 coast stations and 4,846 ship stations. The Marconi system is credited with being used at 225 land stations and 1,894 ship stations, and the Telefunken system at 150 land and 807 ship stations.

CONTRACTS OPEN and CLOSED.

OPEN.

Athy.—December 6th. U.D.C. Tenders are invited for lighting the town with electricity. Particulars from Mr. J. A. Lawler, Town Clerk.

Australia.—ADELAIDE.—January 19th. P.M.G. Common-battery switchboard. See "Official Notices" November 19th.*

January 26th. Deputy P.M.G. Twenty tons of galvanised-iron wire, 400 lb. to the mile.*

BRISBANE.—P.M.G. January 26th.—Galvanised-iron wire. December 1st.—Measuring instruments. January 5th.—Jointing sleeves and copper-clad steel wire. See "Official Notices" November 19th.

January 26th. Deputy P.M.G. Telephone instruments, parts and accessories.*

SYDNEY.—December 20th. Metropolitan Board of Water Supply and Sewerage. Three centrifugal pumps and electric motors, with switchboards, starters, &c., for the pumping station at Marrickville, N.S.W. Deposit £10. Tenders to the Board, at 341, Pitt Street, Sydney, N.S.W.*

January 31st, 1916. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

February 28th, 1916. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

MELBOURNE.—January 4th. P.M.G. Electric measuring instruments, telephone parts, and automatic common-battery telephones.*

Beckenham.—December 12th. U.D.C. 2,000 tons of Midland slack coal (100 tons per week from January 1st, 1916), for the Electricity Department. See "Official Notices" to-day.

Durham.—December 10th. Twelve months' supply of electrical fittings, for the Trimdon Grange Colliery Co. Storekeeper, Trimdon Grange Colliery Co. (Co. Durham).

London.—December 9th. H.M. Commissioners of Works. Twelve months' supply of electric cable and wire. See "Official Notices" to-day.

WEST HAM.—December 16th. Three months' supply of electrical fittings, for the B. of G. Forms of tender from Mr. T. Smith, Clerk, Union Road, Leytonstone, N.E.

Manchester.—December 6th. Steelwork and foundations for new boiler house; also foundations for cooling towers at Stuart Street station. Messrs. C. S. Allott & Son, Civil Engineers, Brown Street, Manchester.

New Zealand.—WELLINGTON.—December 8th. Public Service Stores Tender Board. 6,700 telephone cords, 120 miles twin-twisted rubber-insulated wire.*

South Africa.—DURBAN.—January 5th. Corporation Telephone Department. (1) Telephone apparatus and materials; (2) underground cables; (3) 540 c.i. pipes, 9 ft. long, for cables. Messrs. Webster Steel & Co., 5, East India Avenue, E.C., are the Corporation's London agents.*

Spain.—December 8th. Municipal authorities of Piedrahita. Concession for the electric lighting of the town during a period of ten years.

Tenders have just been invited by the municipal authorities of Santa Coloma de Farnes (Province of Gerona) for the concession for the electric lighting of the town during a period of ten years.

Walthamstow.—December 15th. U.D.C. Supply of low-tension cable, for the Electricity Department. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—TASMANIA.—The tender of the British General Electric Co. has been accepted by the Public Works Department for power plant at the Mental Diseases Hospital, New Norfolk, at £2,347; and that of Messrs. A. J. Todd & Co. for electric lighting installation and overhead equipment, at £435.

The following contracts have been placed by the Victorian Railways Department:—

Electric lighting material for the Jolimont car-repair shop.—Siemens Bros. Dynamo Works, Ltd.; B.I. & Helsby Cables, Ltd.; Aust. General Electric Co.

One 5-ton electric crane, £1,187.—Babcock & Wilcox, Ltd.

Motor-generator, switchboard and accessories, for battery-charging at Jolimont repair shop, £266.—Lascelles Parrington. —*Tenders.*

Manchester.—The Tramways Committee has accepted the tender of Messrs. F. Smith & Co. for copper trolley wire, and that of Messrs. Edgar Allen & Co., Ltd., for special trackwork, point tongues and crossings. The Electricity Committee has accepted the following tenders:—

Cable.—Western Electric Co., Ltd.

Asphalt troughing.—Howard Asphalt Troughing Co., L'd.

One 5,000/6,000-kw. turbo-alternator.—B.W. Electric & Mfg. Co., Ltd.

One 5,000-kw. high-pressure turbine.—James Howden & Co., Ltd.

Salford.—The Electricity Committee has accepted the tender of Newall's Insulation Co., Ltd., for covering with composition various lengths of steam piping at the generating station, for £33 10s. Mr. J. Heaton, of Ramsbottom, is to supply during the next six weeks 300 tons of Garswood slack, at 15s. 3d. per ton, and 300 tons of Brodsworth slack, at 15s. 9d. per ton, with an extra charge not exceeding 1s. 3d. per ton for cartage to the generating station.

FORTHCOMING EVENTS.

University College, London.—Fridays, December 3rd and 10th. At 5 p.m. Fifth and sixth lectures on "Electric Heating and Electric Furnaces," by Prof. J. A. Fleming, F.R.S.

Salford Technical and Engineering Association.—Saturday, December 4th. Visit to the Salford Corporation Cleansing and Flag-Making Department, Langley Road Depôt, and Annual Meeting.

Royal Society of Arts.—Monday, December 6th. At 4.30 p.m. At John Street, Adelphi. Cantor Lecture, on "Optical Glass" (Lecture II), by Dr. W. Rosenhain, F.R.S.

Wednesday, December 8th. At 4.30 p.m. Paper on "The Art of Finding Your Way at Night Without a Compass," by Lieut.-Col. W. A. Tilney, late 17th Lancers.

Rontgen Society.—Tuesday, December 7th. At 8.15. At the I.E.E., Victoria Embankment, W.C. Papers on "Some Remarks on Fluorescent and Intensifying Screens," by Mr. L. A. Levy; and "Further Notes on Localisation," by Mr. G. G. Blake.

Institution of Electrical Engineers (Yorkshire Local Section).—Wednesday, December 8th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "Some Difficulties of Design of High-Speed Generators," by Prof. A. B. Field.

(Students' Section).—Thursday, December 9th. At 7.45 p.m. Address on "The Institution," by Mr. J. E. Kingsbury, Hon. Treasurer.

Association of Engineers-in-Charge.—Wednesday, December 8th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Ammunition Manufacture," by Mr. A. E. Penn.

Faraday Society.—On Wednesday, December 8th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. General Discussion on "The Corrosion of Metals."

Greenock Electrical Society.—Friday, December 10th. At 7.45 p.m. At Temperance Institute, 19, West Stewart Street. Paper on "Electric Tramways," by Mr. J. Punch.

North of England Institute of Mining and Mechanical Engineers.—Saturday, December 11th. At 2 p.m. At Neville Hall, Newcastle. General Meeting.

NOTES.

Electrical Vehicle Committee.—A letter, of which the following is an abstract, has recently been widely circulated amongst the heads of municipal departments by the E.V. Committee, through its honorary secretary, Mr. Frank Ayton:—"The Manchester Corporation have recently served notices upon a large number of owners and tenants in the city to abate an alleged nuisance by discontinuing to keep horses on their premises. It is likely that this commendable action by the Sanitary Committee of the Manchester Corporation will be followed by other progressive cities and towns, since it is admitted by all who are qualified to give an opinion that the presence of stables in urban areas is harmful to the public health.

"If horses are to be displaced in this way, motor traction in some form will have to be adopted.

"From the standpoint of public health, the petrol vehicle is also most objectionable, owing to the noxious gases emitted by the exhaust and also to the nerve-racking noises caused by the engine and gears, especially at central garages. On the other hand, the electric battery vehicle is in every way an ideal vehicle for town use.

"My Committee, therefore, suggest that municipalities should make special efforts to encourage the use of the electric battery vehicle in the areas under their control. The most convincing way of doing this is to set the example by using such vehicles for municipal work, such as watering roadways, scavenging, house refuse removal, cartage of road and other materials, ambulance work, fire brigade work, cartage of coal and ashes, as well as for passenger transportation by means of electric battery omnibuses. Smaller electric vehicles can also be used to advantage for the transportation of officials in the performance of their duties.

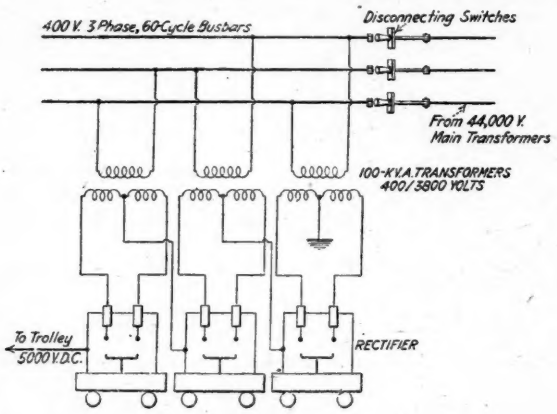
"Not only will the adoption and use of electric vehicles in these directions gradually have the effect of doing away with stables, but it will, in addition, bring a handsome revenue to the electric supply undertaking which nearly every municipality nowadays owns.

"My Committee wish particularly to emphasise the point that there is nothing experimental about the modern electric vehicle."

Dublin Electrical Dispute.—The Right Hon. T. L. O'Shaughnessy, Recorder of Dublin, sat in his Chambers at Green Street Courthouse, as arbitrator in the dispute between Dublin master electricians and their men. The latter, who had been on strike on the question of wages for some time past, had returned to work pending his Lordship's decision. After lengthened and careful consideration, the Recorder decided that the men should be granted ½d. per hour, their wages being raised from 9½d. to 9¾d per hour. He also decided that those engaged on War Office work should be granted a bonus of 6d. per day. The men's demand was for 11d. per hour, apart from war bonus.

Direct-Current 5,000-volt Railway Operation.—In the use of direct current for electric railways the trolley voltage of 600, so long considered the limit, has, during the past few years, increased to 1,200, then to 1,500 volts for interurban service, and 2,400 volts for heavy electric traction. A further step in increasing the voltage was the electrification of the Chicago, Milwaukee and St. Paul Railway at a trolley voltage of 3,000. Now, however, we have 5,000-volt direct current for interurban work, which has been in use since June 1st on an experimental line of the Michigan Traction Co.; this important advance has been rendered possible through the co-operation of the company's engineers with those of the Westinghouse Co., who worked out the details of the equipment.

Direct current at 5,000 volts is obtained from steel-tank mercury-vapour converters having their alternating-current terminals connected one set to each phase of the 400-volt three-phase 60-cycle bus-bars and the direct-current terminals connected in series, as shown in the diagram. This installation is the first in



which mercury-vapour converters have been connected in this way to a three-phase circuit, or have been used to produce so high a direct-current voltage. It is also the first case in which converters of the steel-tank type have been operated on 60 cycles.

The car equipment consists of four motors, each rated at 100 H.P., 2,400 volts, connected two in series for operating on 5,000 volts. The use of such a high voltage as 2,500 at the terminals of each motor is made possible by the fact that they are of the double-armature type, in which each field frame contains two separate armatures with independent pinions meshing with a common gear. While the voltage at the terminals of the motor is 2,500, that at any commutator is limited to 1,250.

It has been found in practice that the flashing at the switches on this car, with 5,000 volts on the trolley, is notably less than when a 600-volt car is handled in the same way. This is due to the extremely small current required.—*Power.*

Value of Clean Bottles for Sampling Transformer Oil.—The insulation strength of the oil in all transformers used on circuits operated above 6,600 volts in the system of the Georgia Railway and Power Co., Atlanta, Ga., is tested once each month. When the oil shows an insulation strength lower than 40,000 volts it is filtered and tested until this strength is secured. It is well known that a small amount of moisture in oil greatly reduces the dielectric strength, and inasmuch as a small sample must be taken for test, it has been found that extreme care must be exercised to secure the sample and deliver it to the test room in the same state as that in which it is found in the transformer case. To make this possible a specially prepared 4-oz. sample bottle is furnished to station operators for delivering the monthly samples for test. These bottles are prepared by washing and rinsing in gasoline; they are then dried and the corks inserted. The cork and mouth of the bottle are then dipped in heated paraffin, which seals the bottle air-tight.

The value of this precaution was recently shown when a new attendant who did not believe in the value of the prepared bottle sampled the oil from a transformer and delivered it in a used bottle to the test room. The oil punctured at 32,000 volts, and was ordered to be filtered. The attendant secured a new sample of the oil and delivered it in a specially prepared sample bottle, when it tested at 42,000 volts. This attendant now finds it easier to use the bottle than filter the oil.

About 0·04 per cent. of water will reduce the dielectric strength of oil to about 10,000 volts, the curve of decrease being very steep up to about 0·80 per cent., when the dielectric strength decreases more slowly as water is added. The need in sampling oil of care such as that exercised in this case is therefore apparent, and the method used is a very simple one to eliminate errors in tests. —*Electrical World.*

Armature Repairs and Rewinding.—A "Reader of many years' standing" of this journal would be glad if any of our readers would give him information as regards the most suitable plant and instruments to be used in conjunction with the rewinding of A.C. and D.C. machines, also the approximate floor space required. The maximum size of armature would be 100 KW.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS.—Orders for Week commencing December 6th, 1915.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Saturday, December 4th.—Parade in uniform at East Putney Station, at 2.45 p.m. See below.

Monday, December 6th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, December 7th.—School of Arms with Architects' Corps, 6 to 8 p.m.

Thursday, December 9th.—Sections 1 and 2, Shooting.

Friday, December 10th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad. Signalling Section and Recruits.

Saturday, December 11th.—Instruction Class at 2.30 p.m.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

Train on Saturday for East Putney on District Railway, leaves Mansion House Station at 2.22 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, December 2nd, 1915:—

Week-end Parades.—Saturday.—Field Operations. Parade at Baker Street Station at 2.30 p.m. Detailed instructions will be sent later to officers concerned. The Commandant's Class will parade in the ante-room of the Officers' Mess at 3.15 p.m.

Sunday.—7 a.m., Reveille; 10 a.m., Church Parade; 10.20 a.m., Parade under Company Comm uders. The Battalion will parade at 2 p.m. and march to the Hendon Aerodrome, where a demonstration of flying will be witnessed, and it is hoped that a lecture will be given to the Corps.

Winter Quarters.—A voluntary fatigue party is required for work on the winter quarters on both Saturday and Sunday next, the 4th and 5th inst. Members offering their services for this duty will report to the Camp Quartermaster at Wembley Park, at 2.30 p.m. on Saturday and 10 a.m. on Sunday.

Musketry.—There will be no shooting at Acton on Saturday, the 4th inst.

Bisley.—The range will be open all day for members of the Corps. Names to be sent in to Headquarters, as usual. Members going down in the morning should report to Sergeant Cotter at the barrier of No. 9 Platform, Waterloo Station, at 9.15 a.m. Those unable to travel at that time should apply for travelling vouchers at Headquarters not later than 4 p.m. on Friday, the 3rd inst.

A. G. JOINER, *Major and Adjutant*, O.B.C.

What a Big Concern Can Do.—In the course of a recent address on "Modern Tendencies," Mr. T. N. Vail, president of the American Telephone and Telegraph Co., referred to the recent development of the telephone, culminating in trans-Continental telephony, and pointed out that this achievement would not have been possible except in the hands of a single concern with ample resources. In the same way wireless telephony has been developed by the Bell company until conversation has been made possible over a distance of 4 000 miles; this also could never have been accomplished by any number of small unassociated companies. Incidentally, Mr. Vail said: "Talking over the wireless is like talking in a boiler shop; earth currents and electrical disturbances which sweep through space are picked up by the wireless antennæ and translated into noise by the delicate receiving instruments. These storms are the *bête noire* of the wireless, whether telegraph or telephone, and for months at a time they will be so continuous and so serious as to make wireless communication over great distances impossible and over short distances extremely difficult. There were the same difficulties in the early development of the telephone. The grounded telephone wires, acting as do the antennæ of the wireless station, picked up these same currents and translated them into noise. Some may remember that these noises in early telephone times made conversation always difficult and sometimes impossible. The noises caused by earth currents were gotten rid of by making the telephone circuit of two wires entirely insulated from the earth. The atmospheric disturbances still remained, but were neutralised by transposing the two wires, or virtually twisting them, and in this way the regular telephone conversational current was given a noiseless path. What device will be possible to neutralise the effect of these electrical storm disturbances on the antennæ of the wireless is yet the problem of the future."—*Telegraph and Telephone Age.*

Lighting National Colours on Neutral Ships.—The proper lighting of the names and national colours of neutral ships is a matter of importance now that nights are long and dark, and occasional U-boats still seek anything which floats as prey. A satisfactory solution to the problem is easy where ships have electric lighting plant installed, and in other cases acetylene projectors are used successfully to illuminate those parts of the ship's sides on which name and flag are painted. According to *Schiffbau*, a Scandinavian electric sign company is supplying luminous letters for mounting along the centre line of a vessel over its deck structures, so as to be visible on either bow. The bodywork of the letters is of strong zinc sheet, and the glass panels are reinforced by wire netting. Each letter stands about 1 metre high, and contains a 50-C.P. electric lamp or gas burner. The cost of each letter, erected ready for use, is given at £3 6s. for electric light, and £4 8s. for gas. Tungsten lamps can be used in the electric lanterns.

Maturing Wine by Electricity.—Some years ago we described an electrical process which had been tried in France for giving raw wine and spirits the properties they acquire by being kept for a number of years. According to the *Daily Mail*, it is claimed that a successful process has been devised by Prof. Charles Henry, who is able in a few minutes to convert whisky three years old into a mature whisky pronounced by experts to be at least 12 years old. Burgundy is already being ripened and matured by this process in France, and successful experiments have recently been made with beer and essential oils.

Electric Cooking in American Apartment Houses.—The *Electrical World* recently contained some interesting data on the subject of electric cooking in situations where it is used exclusively.

In a Buffalo apartment house 95 electric ranges are in daily use; data is given for four months during which time the number of families reporting increased from 23 to 44, and the average cost for lighting and cooking ranged from $2·31 to $2·51 per month. A single meter tariff was in use, the charge for the first 15 units being 7 cents per unit, next 30 units, 5 cents, and all over, 1½ cents per unit.

Figures for a tenant in an apartment house at Great Falls, Mont., show a monthly cost per person (seven in family) varying from $·26 to $·42, with electricity at 3 cents per unit; similar figures for a Great Falls residence (seven persons) show a monthly cost per person of from $ 30 to $·49.

For families of three to six persons in Salt Lake City, the average cost per day per person varies from 1·3 to 3·3 cents, with energy at 3 cents per unit.

An instructive table giving data relating to four apartment house installations using 83 Simplex Heating Co.'s ranges, is as follows:—

Location.	KW.-hr. per person per day.	No. of ranges.	Rated load KW.	Maximum demand, KW.	Maximum load, rated load in per cent.
Worcester, Mass. ...	0·93	16	77	13·5	17·50
Great Falls, Mont	1·12	21	110·25	13·5	12·35
Salt Lake City, Utah	0·85	24	77	11·5	15·00
Anaconda, Mont. ...	0·97	22	92	—	—
Average... ...	0·96	—	—	12·8	15

The data given are sufficient to enable conclusions to be drawn as to average results in American practice.

British Association, 1916.—At a meeting held on November 24th, the Newcastle-on-Tyne City Council formally resolved to invite the B.A. to meet there next year on lines similar to those adopted at Manchester this year.

Russia's Proposed Electricity Tax.—A Congress has been held on the proposed taxation of electricity in Russia. Mr. A. J. Nikolaienko, Temporary Director of the Ministry of Finance, who presided, spoke briefly on the history of the proposition. The meeting had before it the *projet de loi*, prepared by the Chief Department of Indirect Taxes, with an explanatory report. On the question of the desirability of taxing electric current, the representatives of electrotechnical science and industry observed that in view of the necessity to obtain money they were prepared to recognise the taxation of current required for lighting. Some of them agreed also to taxation of power for tramway systems, but in the case of current for industrial purposes, it was considered that such a tax might be a burden, both for the existing electrical industry and for the industries themselves that used the current as a motive power. The Director of the Chief Department of Indirect Taxes, S. S. Chripunoff, said that the *projet de loi* empowers the Ministry of Finance to reduce the rate, or even to grant complete exemption in suitable cases where the imposition of a tax would be burdensome. Prof. P. P. Migulin said that to tax electrical energy was necessary from a financial point of view, the more so that this tax did not so much affect the industry itself as the consumers. Prof. M. I. Bogoliepoff said that at present this question should be decided from another point of view. The country was on the eve of the introduction of new taxes, and there was no free choice. The whole question resolved itself into this—could they stand a new tax or could they not? The meeting had not discovered anything contrary to the latter. Referring to the effort in England, where similar taxes were always considered in the light of the necessities of industry, Prof. M. I. Bogoliepoff further observed that in the new taxes recently introduced into England for a colossal sum, the Chancellor of the Exchequer had said that at a certain point it was impossible not to ignore the fact that a certain amount of injury accompanied the operation of taxes on industry. In England they did not hesitate to tax motor spirit; that was to say, in a certain case they taxed motor power, and in the motives and measures of the English fiscal policy they might find pointers for Russia, whose financial needs were considerably greater than those of England. In further discussion, the question of the technical effects or otherwise of a tax were comprehensively considered, and a further consideration was given to the proposed statutes regulating the new tax, and several changes were made in the text of the *projet de loi*.

Nearly a "Dead" Short-Circuit.—A street-railway inspector was testing some trolley insulators suspected of being defective in their insulating qualities. The test was made in a car barn with a wooden floor by placing each insulator in series with a voltmeter, and from the reading and known resistance of the voltmeter the calculation was made. A file was used to clean the metal work so that a good contact could be made. The inspector held the trolley connecting wire and touched it against the insulators as the case required, while his helper held the ground wire, and being well insulated on the wooden floor, there was little danger. The tests were going along beautifully until the inspector failing to reach the file, the helper picked it up and handed it to him. The next second, both were flat on their backs wondering what had hit them. In passing the file (which had no handle) they had connected themselves across the 500-volt direct-current circuit. The rest of the tests were conducted on the "safety-first" principle.—A. P. Connor, in *Power*.

Estimating Distance at Sea.—In *Nature*, last week, an ingenious method of estimating distance at sea in fog or thick weather, devised by Prof. J. Joly, was described in the course of a report of the proceedings of the Royal Society. The method is based upon the different velocities of disturbances in different media. If aerial and submarine signals are simultaneously emitted at a lighthouse station or lightship, the lag of the aerial compared with the submarine sound is about 4·3 seconds to the nautical mile. An approaching ship picking up the signals and measuring the lag to an error even of one second, becomes aware of her distance to less than one-quarter of a mile. Similarly, wireless signals and submarine signals, or wireless and aerial signals, may be used. If the faster-moving signals be sent out in groups, the individual signals being spaced at regular intervals—say, of one second—and the slower moving signal be always emitted simultaneously with the first signal of a group, the navigator has only to count the faster signals until the slower signal reaches him, in order to estimate his distance from the signal station. In this case the signals themselves tell him his distance, and no actual time measurements are required on board ship. If vessels possess the means of emitting a loud and crisp sound signal which can be sent out simultaneously with a wireless or a submarine signal, the determination of distance rendered possible thereby, along with wireless information as to course and speed, will enable the navigator on each ship to determine with certainty (1) whether there is risk of collision, or whether there is no risk, and (2) the point upon his own course, and the moment at which collision is threatened. The solution of the problem is based upon the fact that at each instant the rate of mutual approach is the maximum if the ships are advancing so as to collide. A simple geometrical construction, which by its character is unlikely to involve error, enables the mariner to solve the problem immediately the signals are received.

Aeronautical Production.—The Aeronautical Production Committee of the Aeronautical Institute of Great Britain, after closely investigating the causes at present retarding production, has evolved adequate methods whereby it can help to speed up the production of aircraft to the highest point, and is ready to commence its work. It states that a greater increase in rate of production than now obtains can be achieved only by adequate organisation in directions beyond the sphere of the great aeronautical work which is being actually carried on by the Government. To run the whole work of organisation with full effect the Committee requires £5,000, and in order to obtain this the Executive Committee of the Aeronautical Institute invites 5,000 suitable persons to become members of the Institute, at a subscription of one guinea each, or a smaller number to make donations. Its address is temporarily at 39, Victoria Street, Westminster, S.W., where all inquiries will be answered.

Walford Bodie Prosecuted.—At the Birmingham County Court on November 29th, Abraham Weisenberg, a tailor's presser, sought to recover damages from Walford Bodie, music hall performer, for having administered to plaintiff a more powerful electric shock than he undertook to give, with the result that he was knocked down, his right arm and hand were injured, his bodily health was impaired, and he lost seven weeks' earnings. The claim was made on the ground of the defendant's negligence. The case was adjourned until April next.

Corrections for the Hefner Lamp.—Recent researches carried out at the Laboratory of the Schlieren Works of the Zurich Gas Undertaking by Dr. E. Ott, member of the International Photometric Commission, show that the illuminating power of the Hefner lamp is given by the formula—

$$y = 1{\cdot}049 - 0{\cdot}0055\,x + 0{\cdot}00011\,(b - 760)$$

where y = the illuminating power in Hefner units = 1 when the atmospheric humidity = 8·8 l. and the carbon dioxide present amounts to 0·75 l. per m.³ of pure dry air, and the atmospheric pressure is 760 mm.;

x = volume of aqueous vapour in litres per m.³ of pure dry air;
and b = the atmospheric pressure.

It will be noticed that no term appears for carbon dioxide; it is assumed that observations will be made in well-ventilated rooms, in which the proportion of CO_2 present averages 0·75 l. per m.³ of pure dry air.

Electric Heating and Electric Furnaces.—In his fourth lecture, on Friday last, Dr. Fleming dealt with arc furnaces, of which the first of commercial importance was that of Stassano, which was used for the production of special alloy steels. As this furnace was heated by radiation from the arc, in order to avoid contamination of the steel with carbon, the efficiency was very low, the energy consumed in the reduction of 2½ tons of steel amounting to 1,360 units per ton. This has been reduced in later designs to about 900. The Héroult arc furnace, charged with liquid pig and pure scrap iron, had carbon electrodes, which were lowered upon the charge to start the arc, and then raised; the furnace consumed 800 to 900 units per ton of steel. The Keller furnace was an attempt to imitate the operation of the blast furnace in smelting iron ore, and was fed with iron ore, coke, and lime; 16 tons of pig iron could be produced for 2,292 units per ton. As the ordinary blast furnace consumes 16 cwt. of coke per ton of pig iron produced, of which 6½ cwt. is required to deoxidise the ore, the greatest saving that can be effected by the electric furnace in smelting iron is 9½ cwt. of coke per ton of pig, costing 8s. a ton, so that in order to compete with the blast furnace, electrical energy would have to be supplied at $\frac{1}{10}$d. per unit, or £1 per H.P.-year, about half the lowest price now obtainable. The only chance for electrical smelting, therefore, is where water-power and ore are together and cheap, and coke is dear. The problem is being studied in Norway and Sweden.

In the Girod furnace only one carbon electrode was used, iron electrodes being embedded in the floor of the furnace. A three-phase furnace had three electrodes, which formed a three-phase arc on the top of the charge, and additional electrodes were provided outside the magnesite lining, which became conductive when hot. Messrs. Verdon Cutts and Hoult designed an electro-Bessemer furnace, in which air was blown through the charge to oxidise the impurities.

Pointing out the importance of employing electrodes of the most efficient dimensions, because they conduct heat outwards from the furnace, the lecturer described the original investigations of Mr. Carl Hering, who was the first to discuss the subject analytically, and showed how to arrive at the cross-section which gave the minimum loss of heat.

Fatality.—At an inquest held at Skinningrove (Cleveland), on Monday, the question arose as to whether the deceased, a Loftus mines electrician named Charles Markham, had died from electric shock. It was stated that deceased had been engaged in cleaning out the electric controller and a haulage engine, and started the machinery to test it. He placed his left hand on the outer casing of the motor, but almost immediately fell and groaned. When a doctor arrived Markham was dead. A witness, in response to questions, said he did not consider the outer cover of the motor dangerous. Markham was not wearing gloves. Dr. Donaldson said he found a mark as of a burn on the right wrist. The condition of the body was consistent with deceased having received a shock. The mine manager, Mr. Wm. Moore, said he thought the flesh would have been injured or burnt if deceased had had a shock. "Death, probably from electric shock," was the verdict.

Situations Vacant.—Assistant in engineering department (37s.), for the Wolverhampton Union; shift engineer (£2), for the Oldham Corporation electricity department; engineers, 45s. 6d. (7 days), for H.M. Dockyard, Pembroke Dock. Particulars are given in our advertisement pages to-day.

Converted Repair Shops.—Messrs. Rawlings Bros., Ltd., of Kensington, recently re-arranged the motor-car repair shops at the private mansion of a well-known public man for munitions making, and a very acceptable monthly output of shells will result. The owner of the mansion has two sons at the Front, but he is anxious to do more, hence, by the aid of the electrical installation, three screw-cutting lathes, drilling machines, &c., are rendering a good account of themselves. Messrs. Rawlings ask all who have lathes or other machines lying idle to get into touch with them, so that they may give them the benefit of their experience in converting the above repair shops.

Professional Classes War Relief.—On Wednesday, Thursday and Friday next week a "Christmas in War Time" Sale will take place at the Albert Hall, on behalf of the Professional Classes War Relief Council; it will be open from 1.30 to 10 p.m. on December 8th, admission 5s. The entrance fee, which is reduced to 2s. 6d. on Thursday evening and Friday morning, and 1s. on Friday evening, entitles the visitor to an article of the same value. Entertainment will be provided by well-known artistes, and many of the articles sold will be novel to this country, being made by Belgians who are occupying the I.C.S. premises at Hendon. Gifts for the sale should be addressed to the Gifts Secretary, Albert Hall, S.W. The articles will be useful Christmas gifts, at ordinary market prices.

The object for which the Council works, as we have previously explained, is most deserving of support, as many members of the professional classes have been very hard hit by the war, and are in great distress.

Patents and Alien Enemies.—The Board of Trade has granted licences to Messrs. G. H. Forrester and G. Marsh in respect of patents Nos. 12,868-69-70, 1905, granted to Goldschmidt and Weber for detinning plates.

Institution and Lecture Notes.—The Faraday Society.—On Tuesday, December 8th, the Society will hold a general discussion on "The Corrosion of Metals, Ferrous and Non-Ferrous," at the Institution of Electrical Engineers. The discussion will be preceded by the reading of papers by Mr. Leslie Aitchison, Dr. C. H. Desch, Dr. J. Newton Friend, Mr. W. E. Gibbs, Mr. Bertham Lambert, Mr. Arnold Philip and Mr. S. Whyte, after which the subject will be open to general discussion. Those desirous of attending can obtain tickets on application to the Secretary, 82, Victoria Street, S.W.

The Rontgen Society.—The Report of the Council for the year ended June 30th last shows that the membership has increased, and the financial position of the Society is satisfactory. The principal officers for the session 1915-16 are:—President, Mr. J. H. Gardiner, F.C.S.; hon. treasurer, Mr. G. Pearce; hon. secretary, Dr. R. Knox.

Diesel Engine Users' Association.—At the November meeting the subjects of income-tax assessment and allowance for depreciation, and the rise in the price of fuel oil, were considered, and the discussion on the subject of cracked and seized pistons was resumed. The next meeting will be held on December 20th.

Institution of Electrical Engineers.—(Students' Section). The following arrangements are announced:—

Thursday, December 9th, at 7.45 p.m., address on "The Institution," J. E. Kingsbury,
Wednesdays at 7.45 p.m.—
December 15th: "The Aluminium Electrolytic Arrester, with an Introduction on Electrical Disturbances," A. G. Ramsey, B.Sc.
February 2nd, 1916, "The Methods employed for the Wireless Communication of Speech," P. R. Coursey, B.Sc.
February 16th: "The X-Ray Tube and Modern Practice," W. J. Jones.
March 1st: Discussion on "Suggested Applications of Science to Warfare."
March 15th: "Long-distance Transmission Lines," E. T. Driver, B.Sc.
March 29th: Annual General Meeting.

A meeting of the Manchester Local Section was held on Tuesday, when Prof. A. B. Field read his paper on "Some Difficulties in the Design of High-speed Generators," and a discussion followed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. N. W. Prangnell, distributing engineer with the Metropolitan Electric Supply Co., Ltd., has obtained a temporary lieutenant's commission in the R.N.V.R., and is taking up duties in the electrical department of H.M.S. *Vernon*.

Derby Corporation Electricity Committee has appointed Messrs. G. J. Scale and W. L. Letchford, switchboard attendants, as junior charge engineers, at £120 a year, and Mr. C. Pearce as switchboard attendant.

Mr. G. D. Vickers has resigned his position as managing engineer of the Banbury & District Electric Supply Co., Ltd., in order to take up a position as resident engineer under the Shropshire & Worcestershire Electric Power Co. at their Dudley station. He was presented by the staff of the Banbury Co. with a case of pipes.

Tramway Officials.—Mr. T. Hanlon, of the staff of the Isle of Thanet Tramway and Lighting Co., Ltd., who is leaving to take up a position on the Oxford Tramways, has been presented by the staff with an inscribed brass hall gong and a pipe and tobacco pouch.

General.—The Foreign Office, in its report on the attack on H.M. Consul and the British Colony at Shiraz, Persia, states that on November 10th the Persian gendarmerie suddenly seized, without any warning, H.M. Consul, the superintendent of the Indo-European Telegraph Department, and others. The wife of the telegraph superintendent subsequently arrived at Bushire under escort of gendarmes. The gendarmerie, who hold Kum (70 miles south of Teheran) in the interests of the Germans, have cut the line of the Indo-European Telegraph Department to the South.

At a smoking concert held at the South Lancashire Tramways Company's Social Club, Howe Bridge, last week, presentations were made to Sergt. E. Herbert, Pte. E. McGuinness, Pte. Harry Smith, and Pte. George Smith, four former employés of the company who have returned from the Front wounded. Mr. E. H. Edwardes, general manager, handed over the gifts, which took the form of cigarette cases and pipes.

Alderman Wm. Thompson has been appointed chairman of the Blackburn Electricity and Tramways Committee, and Councillor C. Higham vice-chairman.

Mr. F. H. Bruce-Dundas, at present erector-in-charge with the General Electric Co., Ltd., at Witton, has been appointed power-house superintendent for the Orgreave Colliery, of the Rother Vale Collieries, Ltd., Treeton, near Rotherham.

Alderman Duncan Watson has been re-elected chairman of the St. Marylebone B.C. Electric Supply Committee.

Mr. G. S. Helme, A.M.I.E.E., chief assistant to Messrs. Kelsall & Parsons, engineers, Glasgow, has been gazetted

second-lieutenant to the 3/3rd Highland Howitzer Brigade, R.F.A., at present stationed at Greenock.

It is announced that the Board of Trade has appointed Mr. R. W. Dalton, of the Commercial Intelligence Branch, to be H.M. Trade Commissioner in New Zealand, in succession to Mr. W. G. Wickham, who is appointed H.M. Trade Commissioner in South Africa, Sir R. Sothern Holland, who has hitherto held that appointment, being now engaged under the Ministry of Munitions.

Mr. W. T. Taylor, to whom we referred a fortnight ago, has lately returned from Bolivia, South America, and has been gazetted a captain of the 1/12th Loyal North Lancs. (Pioneer) Regiment. Captain Taylor saw active service in the Bechuanaland Expedition and the South African war, and he holds medals with eight clasps aggregate.

Councillor Richard Mayne has been appointed chairman of the Newcastle-on-Tyne Tramways Committee, and Councillor A. M. Sutherland vice-chairman.

According to the *Melbourne Age*, the Victorian Railway Commissioners have engaged the following officials in connection with the installation of automatic signalling on the suburban railways, men holding the requisite qualifications not being obtainable in the Commonwealth :—

Mr. G. H. Wion, who was formerly employed by the Pennsylvania Railroad Co., at New York, as an engineer in connection with its power and automatic signalling systems, was engaged in July, 1914, as assistant signal engineer for a term of five years.

Mr. C. W. Prescott, who was dispatched by Mr. Merz to Melbourne in connection with the installation of automatic signalling, has had experience on the London underground railways, and was in February last transferred to the service of the Commissioners for a term of three years.

Mr. T. Kittredge was recently engaged in the United States for a term of three years as a track circuit designer draughtsman, and is now on his way to Melbourne.

Mr. W. J. Huggins was formerly assistant inspector of signals and telegraphs on the Metropolitan Railway, London, and was engaged in December, 1914, for a term of five years as a signal foreman in connection with the installation of power and automatic signalling. Mr. Huggins was also required by the Commissioners for the instruction of the fitters who will be utilised on this class of work.

Messrs. E. R. Fox and F. R. Wilson were also engaged in England in September, 1914, as electrical fitters in connection with the installation of automatic signalling.

Mr. J. Rist, formerly of the Central London Railway, who has had experience as an instructor of motormen, was engaged in October, 1914, to train the motormen, guards, and other employés who will be required to operate the electric trains.

The employés of the Electric Construction Co., Ltd., of Wolverhampton, have presented a purse of Treasury Notes to Mr. S. Antwis, who is leaving the staff after 32 years' service.

Mr. F. Greere Howard, A.M.I.C.E., electrical engineer, of Berners Street, W., was on Monday elected chairman of the Electric Lighting Committee of the Hampstead Borough Council.

Roll of Honour.—Lance-Corporal George H. Badham, 1st North Midland Division, Royal Engineers, late chief assistant to Messrs. S. Thomas Pemberton & Co., of Birmingham, was killed in action on October 12th.

Sergeant J. H. Hodges, of the 8th Battalion Lancashire Fusiliers, formerly employed at the British Westinghouse Works, Trafford Park, has been wounded at the Dardanelles.

Sapper Harry Thorpe Lees, of the Royal Engineers, has been killed by a sniper in France. Deceased, who was 23 years of age, was prior to the war in the employ of the Stalybridge Joint Tramways and Electricity Board.

Mr. Albert Schloesser, who was with the British Westinghouse Co., Trafford Park, is officially reported missing. He was wounded in France some months ago, and nothing has since been heard of him. Prior to the war he was in Canada, and he joined the Canadian Scottish.

Sapper John Frederick Beney, of the Royal Engineers, who has fallen in action in France, was a railway electrician.

Lance-Corporal W. A. Smith, of the 2nd Queen's Regiment, who has been killed in action at Loos, France, was prior to the war on the staff of Messrs. R. W. Blackwell & Son, Ltd.

Lance-Corporal H. Wise, of the 7th South Staffordshire Regiment, who was prior to the war engaged at Rugby with the British Thomson-Houston Co., Ltd., has been killed in action at the Dardanelles.

Company-Sergeant-Major Lindsay, of the 1/4th Loyal North Lancs. Regiment, who was prior to the war on the staff of the United Electric Car Co., Ltd., of Preston, has been awarded the Distinguished Conduct Medal for conspicuous bravery in France.

Gunner W. Billingham, of the Royal Field Artillery, who was prior to the war engaged in the winding department of the British Thomson-Houston Co., Ltd., of Rugby, has died from wounds received in action at the Dardanelles.

Mr. William Oakley Garrett, who was killed in the battle at Ctesiphon, was employed, prior to the war, in electrical engineering work in India.

Municipal electrical men will have learned with regret that Sir John and Lady Courtis, of Llandaff, Glam., have suffered the loss of their eldest son, Captain J. H. Courtis, he having been killed in Mesopotamia, November 22nd-24th, at the age of 27 years.

Bombardier A. E. Ellis (46,446), 106th Brigade, R.F.A., who has been awarded the Distinguished Conduct Medal, was before the war a clerk in the gutta-percha department at the works of the India-Rubber Co., at Silvertown. The official report reads: "For conspicuous gallantry on September 25th, 1915, near Vermelles. He displayed great courage and resource in repairing telephone wires in 17 different places, thus enabling communication to be kept up. This work he did in the open, and under a very heavy shell fire."

Obituary.—M. Adolphe Greiner.—We deeply regret to learn of the death of M. Adolphe Greiner, director-general of the famous John Cockerill Co., and president of the Iron and Steel Institute, which occurred at Seraing, Belgium, on November 20th. M. Greiner, who was 72 years of age, joined the Cockerill Co. as engineer-chemist when he was 21 years of age. Since 1887 he has been director-general of the company. Readers of the Electrical Review have been made familiar through our own articles, and through papers read by M. Greiner before the Iron and Steel Institute, and published in our pages, with the important pioneering work for which he was responsible in connection with the utilisation of blast furnace and coke oven gases, and in the employment of electrical transmission in steel works. The *Times* states that he was among the first to adopt Parsons turbines on the Continent. *Engineering*, in a brief reference to his death, recalls that the Seraing works were invested by the German armies in August last year. At the time of the last meeting of the Iron and Steel Institute, at which he was to have presided, it was announced that he was practically a prisoner in his own house, having fallen ill through strain and worry.

Mr. G. Clarkson.—The death is announced of Mr. George Clarkson, who had been in charge of the electricity plant at Thurland Castle, Tunstall (Lancs.).

Mr. H. C. Donovan.—We regret to record that the death occurred on November 23rd, at Blackheath, at the age of 73 years, of Mr. Henry Cornelius Donovan, M.I.E.E., late of the Telegraph Construction & Maintenance Co., Ltd.

We tender to Mr. A. M. Sillar, M.Inst.C.E., our sincere sympathy on the death of his wife, which occurred at Waddon, Surrey, on November 29th.

Wills.—The late Major H. R. Chapman, a director of Clarke, Chapman & Co., Ltd., left £17,389.

The late Mr. Edwin Danks, of E. Danks & Co., boilermakers, Oldbury, left £33,192 gross.

NEW COMPANIES REGISTERED.

Quasi-Arc Co. (France), Ltd. (142,217).—This company was registered on November 23rd, with a capital of £5,000 in £1 shares, to carry on in France or elsewhere the business of consulting, civil, chemical, electrical, mechanical, and marine engineers, draughtsmen, manufacturers of, agents for, and dealers in machinery, tools, implements, appliances, and commodities of all kinds, etc. The subscribers (with one share each) are: A. Tiano, 64, Warnford Court, E.C., commission agent; A. Cars, 59, Mark Lane, E.C., merchant. Private company. The number of directors is not to be less than two or more than four; the subscribers are to appoint the first. Qualification, 250 shares. Registered office: Caxton House, Westminster, S.W.

Tredelect Engineering Co., Ltd. (142,245).—This company was registered on November 25th, with a capital of £3,000 in £1 shares (1,000 six per cent. pref.), to take over from H. C. H. Smyth, of 11, Linden Arcade, High Road, Chiswick, the benefit of a certain existing invention relating to improvements in or relating to electric generators for lighting mechanically propelled vehicles, to carry on the business of electrical and general engineers, suppliers of electricity, etc. The subscribers (with one share each) are: H. C. H. Smyth, 14, Foster Road, Duke's Avenue, Chiswick, W., electrical engineer; H. A. Bartlett, 31, Albert Road, Regent's Park, N.W., contractor. Private company. The number of directors is not to be less than three or more than five; the first are H. C. H. Smyth, H. A. Bartlett, and G. F. A. Norman. Registered office: 11, Linden Arcade, High Road, Chiswick.

CITY NOTES.

Allgemeine Elektricitats Gesellschaft.

As a result of the war the directors of the A.E.G. state that they refrain from giving details of the manufactures during the year ended with June 30th, 1915, and the annual report is, therefore, much shorter than has been customary in former periods. It states that the workshops were well employed on articles of peace and war, and were available to a wide extent for the defence of the country. It was not always possible to obtain appropriate compensation in the fixing of sale prices for the considerable rise in wages and in raw materials, especially as the prices agreed to were confronted with greater wear and tear of the machinery and machine tools. The quick and extensive provision of workshops and equipment rendered it possible to effect the transformation in working. The company was, consequently, able to undertake orders for airships and munitions, particularly shells, fuses, cartridges, and grenades, and extensive light and power installations for the Army authorities and for chemical and powder factories had to be carried out. Large guarantees in the form of allocations to the reserve funds had been made for the undertakings in and

debts due from hostile countries and across the sea. The A.E.G.—Union Electrique, of Brussels, had been able to pay 6 per cent., which was, approximately, the same as in 1913-14; the Italian A.E.G.—Thomson-Houston Co., had again paid 6 per cent.; and the A.E.G.—Union Elektrizitats Gesellschaft, of Vienna, 4 per cent., as against 8 per cent in 1913, and the company was well occupied at present. The branches in Scandinavia, Switzerland, Spain, and Holland had carried on business satisfactorily.

The central station department received a considerable share in the contracts for the nitrate and nitrogen installations required by the Government, the Elektro-Nitrum Gesellschaft having given to the company an order for the entire equipment of two nitric acid factories. In addition, the Elektro Werke had ordered a complete great power station of an initial capacity of 185,000 KW., which would be the largest station ever built in Germany at one time. The Bavarian Nitrogen Works Co. had contracted for the transmission line between the power station of the A.E.G.—the Elektro Werke —and the first-mentioned company's chemical works, whilst the A.E.G. had also undertaken to furnish a great switch installation in Upper Silesia and a transmission line between the chemical factories there and the power station of the Silesian Electricity Works. Among the orders received from abroad is mentioned one for the delivery of two turbo-dynamos of 12,000 KW. for an overland station to be erected at a colliery. In the case of the railway department, the report states that the shops were engaged on the comprehensive works for the A.E.G. High-speed Railway, of Berlin, and the completion of the State railway sections between Lauban and Konigszelt and Halle and Merseburg, and the delivery had taken place of three locomotives out of the 27 on order for the Halle line. The Hamburg Elevated Railway would be completed in the current year; but owing to the war it had not yet been possible to put in hand the extensions which were subsequently contracted for. The business in tramways had been essentially limited to the delivery of renewal parts. The accounts show the following figures in comparison with those for the preceding year:—

	1913-14.	1914-15.
Share capital	£7,750,000	£7,750,000
Brought forward	36,000	36,000
Gross profits	1,132,000	1,544,000
General expenses	73,000	77,000
Taxes	106,000	146,000
Interest on loans	—	—
War allowances	—	230,000
Depreciation	44,000	44,000
Net profits	908,000	1,020,000
Bonuses to staff and employés ...	60,000	75,000
Pension fund	50,000	75,000
Dividend	775,000	852,500
Dividend per cent.	10	11
Carried forward	36,000	35,000

Before the balance of profit and loss was struck the sum of £103,000 was written off for depreciation of investments, the total of which stood at £2,843,000 on June 30th, as compared with £2,828,000 in the previous year. Among these are sums of £300,000 representing subscriptions to German war loan, and 1,000,000 crowns (£41,666) to Austrian war loans, which have been considerably increased in the new financial year. The depreciation stated in the table refers to the customary 2 per cent. set aside for buildings, whilst the additional machinery and machine tools have been fully written off, as in previous years, in some undisclosed form, so that the machinery and machine tool accounts appear in the balance sheet at the nominal figure of one shilling for each works. The bank credit on June 30th, 1915, is claimed to have amounted to £4,531,000, as contrasted with £3,848,000 on the corresponding date in 1914, but the payment of claims which has been effected by the Berlin Electricity Works Co. in the meantime has raised the balance at the banks to £5,165,000, as was recently reported. The stocks of raw and semi-finished materials and of manufactures, together with the installations, etc., in hand, represent £4,670,000, as compared with £4,621,000; the reserve fund remains unchanged at £3,678,000, and the contingency reserve at £982,000, whilst the pension fund is set forth at £758,000.

International Light & Power Co., Ltd.

Mr. F. Holt presided, on Monday, at a meeting of the shareholders, held at 9, Cloak Lane, E.C., for the purpose of considering the report and accounts which will be submitted at the annual meeting to be held in Toronto on December 20th.

The Chairman reminded the shareholders that the three properties operated by the company were the Venezuela Electric Light, the Merida Electricity, and the Parana Light and Power Companies. The period covered by the accounts, which were to June 30th last, had been one of unprecedented upheaval in the economic and commercial life of the world, and their interests had, he said, been affected even more perhaps than those of similar undertakings, due to the fact that their Merida property was not only subjected to the effects of the European war, but suffered also from the demoralisation of business and finance during the Mexican revolutions. The cost of coal at Merida had been high, due to the great scarcity of shipping. A portion of the fuel used was wood, and this also had been extremely difficult to obtain on account of labour troubles and the reduction of railway facilities. It had required almost superhuman efforts at times to keep the plant supplied with sufficient fuel to maintain operations, and they were deeply indebted to Mr. Julius, who agreed to go to Merida at a most critical period, and the local manager, for obtaining some profit from the undertaking, and for safeguarding their interests throughout a year of very grave public disorder and difficulty. The depreciation of the Mexican currency continued. The par value of the Mexican dollar was 24d., but at the beginning of the fiscal year this value had fallen to 15d., and it had since still further depreciated to, approximately, 3d. The results of this depreciation were far-reaching; wages and salaries, and the cost of all imported supplies increased, and the value of currency earnings from the sale of electric lighting and power was greatly affected when converted into sterling for the purpose of remittance. The highly efficient Swiss generating machinery urgently required for proper development at Merida, and purchased for that purpose before the outbreak of war, was still, unfortunately, in the hold of a German tramp steamer that had taken refuge in a neutral part. He believed they were now past the most critical period in Mexico, and with the present more peaceful conditions the town of Merida, and with it their property, should quickly recover prosperity. Conditions in Caracas, the field of the Venezuela Electric Light Co., had been as normal as could be expected, considering the effect of the war on general trade conditions, and the currency being on a gold basis there had been no depreciation in the value of remittances. Another advantage in Caracas was that the electricity they distributed was principally generated by means of water power, and, consequently, the high prices ruling for fuel in all parts of the world had not affected the financial results. That was an example of the advantage that a holding company like the International enjoyed in abnormal times by having widely separated geographically the businesses which it controlled. The Parana Light and Power Co. was affected to some extent by the general feeling of uncertainty that followed the outbreak of war. A reduction of earnings resulted for the last four months of 1914, but this was more than compensated for by increased business during the first six months of 1915. The company supplied both gas and electricity, and as the cost of generation was largely that of fuel, the production costs had been affected by the increased price of coal. Economies, however, had been effected in other branches of expenditure, and the result of the year's work had been slightly better than for the previous year. The total revenue received from the subsidiary companies amounted to £28,554, of which debenture interest absorbed £15,000, administration expenses £1,869, interest £1,412, leaving £10,273 to be carried to the balance sheet. The 6 per cent. preference share dividend required £12,328, and reduced the balance brought forward from last year by £2,055. Considering that so many companies had had to suspend payment of dividends since the war, the directors believed that the payment of the preference dividend in full would be particularly welcome to the shareholders at this time; therefore, in view of the substantial reserves and carry-forward of the subsidiary companies, amounting to approximately £29,600, they decided to approve the last quarterly dividend for the year at the full rate, although the earnings for the year were not up to the mark they would have liked. As the Mexican exchange, upon which so much of the profit of the Merida undertaking depended, might not recover as quickly as they could wish, they had decided, pending developments, to defer the payment of further quarterly dividends during the current financial year. The position would be considered as soon as possible after the end of June next, when they hoped that they would be able to declare a final dividend for the year. He concluded by proposing a resolution authorising the directors to support the adoption of the annual report by proxies at the Toronto meeting.

Mr. Francis M. Voules seconded the motion, which was carried.

German Electrical Companies.

The *Elektrische Licht und Kraft Anlagen, of Berlin*, records net profits of £93,200 for 1914-15, as compared with £93,100 in the previous year. It is intended to distribute 5 per cent., being the same rate as in 1913-14.

The *Baugesellschaft fur Elektrische Anlagen, of Aix-la-Chapelle*, which is associated with the Garbe-Lahmeyer Co., of the same town, reports net profits of £5,000 for 1914-15, as compared with £5,900 in the previous year. A dividend of 6 per cent. has been declared on the share capital of £50,000, being the same rate as in 1913-14.

The *Telefonfabrik A.G. vorm. Berliner, of Hanover*, after placing £25,000 to depreciation in 1914-15, as against £10,000 in 1913-14, reports net profits amounting to £101,000, as compared with £41,000. It is proposed to set aside £25,000 as a war reserve fund, and to pay a dividend of 18 per cent., as contrasted with 10 per cent. in the preceding year.

The liquidator of the *E. H. Geist Elektrizitats Gesellschaft, of Cologne-Zollstock*, which company resolved two or three years ago to wind up voluntarily, owing to losses incurred in endeavouring to meet the ruinous competition of the large manufacturing groups, reports a loss of £440 in the year ended with June, 1915, which has been defrayed out of the reserve

fund for liquidation expenses. As a consequence, the deficiency of £24,000 on a share capital of £40,000, which was recorded at the beginning of the proceedings, has been carried forward without any change.

The report of the *Elektrizitats Gesellschaft vorm. H. Poge, of Chemnitz*, states that it was possible to continue full working in 1914-15 within the limits of the reduced number of workers, to dispose of the manufactures at favourable prices on the revival of the demand in the months following the advent of war, and also to work off the stocks and market the output therefrom. After devoting £16,000 to depreciation, as against £18,000 in 1913-14, the accounts show net profits of £21,000, as compared with £20,000, and it is proposed to distribute 7½ per cent., as contrasted with 4 per cent. in the preceding year, on share capital of £225,000.

The directors of the *Wotan Werke A.G., of Leipsic*, report that after the outbreak of the war it was possible to maintain working with the reduced staff, although the company had chiefly to produce for stock. An active demand, however, set in several months later, which was met with the aid of the accumulated stocks, but the scarcity of labour prevented the company from participating in army contracts. The gross profits amounted to £20,000 in 1914-15, as compared with £8,000 in 1913-14, and the net profits to £10,000, as against £8,000. It is proposed to pay a dividend of 20 per cent., as contrasted with 15 per cent. in 1913-14, on an ordinary share capital of £40,000.

The accounts of the *Berliner Elektrizitats Werke* for 1914-15 show gross profits and balance forward amounting to £992,000, as contrasted with £1,164,000 in the previous year, the working results having been prejudiced by the diminution in the consumption through the war, the displacement in the ratio of the lighting to the power consumption, and the increased cost of working. The net profits, after defraying general expenses, interest charges, and depreciation to the amount of £249,000, as compared with £256,000 in 1913-14, are £426,000, as against £567,000, permitting of the payment of a dividend of 9 per cent. on the ordinary share capital of £2,205,000, as compared with 12 per cent. in the preceding year.

The report of the *Elektrische Licht und Kraft Anlagen, A.G., of Berlin*, which is an investment and underwriting company interested in various manufacturing companies in Germany, and in lighting and tramway undertakings both in Germany and in a number of other countries in Europe, has been issued for the year ended with September 30th, 1915. It states that the influence of the war brought about a diminution in the working results. In the case of the native electricity works—with the exception of those in the vicinity of the war zone in Upper Alsace—which at first experienced a large decrease in the consumption, a gradual recovery had taken place, so that the consumption had now essentially reached the level of that prevailing before the war. The manufacturing concerns closely associated with the company, after declines at the beginning and after accommodating themselves to the changed conditions, were at present satisfactorily employed. The connections with the foreign undertakings had been rendered difficult in some instances, whilst those in Russia had been entirely interrupted since the outbreak of the war. It was assumed, however, that the works in operation before the conflict were continuing in regular operation, and the undertakings in course of establishment were brought to a temporary standstill. After giving details of the various interests, the report contains the following figures for the past two years:—

	1913-14.	1914-15.
Share capital paid	£1,500,000	£1,500,000
Loans	1,893,000	1,873,000
Gross profits	219,000	203,000
General expenses	6,500	5,400
Interest on loans	67,000	88,000
Net profits and balance forward ...	93,000	93,000
Reserve fund	8,400	8,400
Dividend	75,000	75,000
Dividend, per cent.	5	5
Carried forward	8,500	8,600

Italian Supply Companies and the War.

The unfavourable results experienced by the Unione Esercizi Elettrici, of Milan, in 1914-15 are attributed in the first place to the earthquake in Abruzzia, which caused serious damage in Aquila, Sulmona and other places in the province where the company supplies electricity, and induced the migration of a large portion of the wealthy population, and, consequently, a corresponding reduction in the receipts. Secondly, the war affected the results, as it terminated the custom of foreigners also on the eastern Riviera, as well as the visits of strangers in Stresa and Bavedo, and at the same time brought about a crisis in industries, such as the marble trade in Pietrasanta and Serravalla, those of asphalt and gypsum in the Abruzzi, and that of cement in Senigallia. In the third place, the entrance of Italy into the war had the direct effect of causing an extraordinary reduction in the consumption of electricity through the migration of the inhabitants from the districts threatened by the war, and the collapse of the visiting season on the sea coast. In addition, the dearth of coal was seriously felt, whilst the Società per l'Utilizzazione dei Combustibili Italiani, in which the Union Co. is largely interested, will presumably soon be compelled, partly as a consequence of the war, to proceed with a scheme of reducing the share capital, and other investments held by the Union Co. are also exposed to a depreciation of more or less extent. The company has, therefore, considered it prudent to set aside £12,000 as reserve for the equalisation of possible losses, to place £8,000 to the depreciation fund, and carry forward the net balance of £280, this result contrasting with a dividend of 4s. 9.6d. per share in 1913-14. A second company which has been adversely affected by the unfavourable situation is the Società Elettrica Milanese, of Milan, which has been compelled to reduce the share capital from £240,000 to £120,000. At the same time, the company is to be amalgamated with the Società Veronese di Elettricita, which has a share capital of £32,000, and is, consequently, to be raised to £152,000.

Norwegian Hydro-Electric Works.

The report for 1914-15 of the Aktieselskabet Hafslund, of Hafslund, Norway, states that the great transformer station at Hafslund was extended during the year, and the double 60,000-volt line Kykkelsrud-Vamma was continued to the new industrial district of the town of Frederikstad, whilst the extension of the Vamma power station was almost completed. The company, which is associated with the Siemens-Schuckert Co., earned net profits of £68,000 after making provision for depreciation to the amount of £8,000, and a dividend at the rate of 8 per cent. is proposed, as contrasted with 7½ per cent. in 1913-14. During the year the share capital was increased from £247,000 to £961,000, one of the objects being to secure an interest of £228,000 in the Glommens Traesliberi Co. The Hafslund company's works are entered at the value of £465,000, of which the hydro-electric works at Sarpsfos represent £168,000.

Mackay Companies.—The directors have declared the usual quarterly dividend of 1¼ per cent. on the common shares.

STOCKS AND SHARES.

Tuesday Evening.

The new French Loan became a matter of consequence to the Stock Exchange markets on this side for days in advance of its actual appearance. It placed an effective stop upon a sharp run up in Consols which lifted the price from 58½ to a couple of points higher, the rise evidently tempting holders to realise; and some of the money, as City men know, was wanted for application to the new French Fives, so temptingly offered. Speaking generally, however, there is a good deal of strength shown by most of the markets round the House; and although the boomlet in rubber shares quieted down with a reaction in the price of the raw material, business in this department is still active.

Up to this evening, nothing fresh has transpired with reference to the truth, or otherwise, of the rumours that led to so smart a rise in the prices of Underground Electric Railways issues. Many people hold that the company could easily modify its fares, on tubes and 'buses alike, without any great hardship to the travelling public; and they explain the demand for the stocks by reference to the probable accuracy of this report. There are, however, other schemes in the air, which may have materialised before the end of the week; so it is scarcely worth while setting them out at length. The Income bonds have gained another couple of points, but even now the yield on them is high enough to be attractive to the speculative investor. Those who regard them as cheap point to the argument that, war or no war, London's demand for transport must inevitably increase, and that the Underground Electric Railways has acquired such a monopoly as to make it practically secure against effective competition, so that the possible scaling down of the interest on the income bonds, say, for a year, must be followed by the full amount being distributed in normal times. The next report is expected to show that the £10 shares have earned a small dividend, although only the optimists look for any payment to be made on these. The price has eased off to 38s. 9d., and the shilling shares reacted nearly 1s. to 5s. 9d. middle.

Following upon the attention drawn to Undergrounds has come a rally in the shares of the London & Suburban Traction Co., the ordinary advancing to 3s. 3d., the preference to half-a-guinea, and the two debenture stocks to 60 and 80 for the 4½ per cents. and the 5 per cents. respectively. The ordinary shares on the outbreak of war stood about 4s., and the preference at 11s. 3d., but for many months the market in both classes has been practically dead. London United Tramways 4 per cent. debenture stock is also finding some support, and stock has changed hands within the past few days at 51. The company continues to pay its interest.

The British Electric Traction Co.'s arrangements for final amalgamation of the various stocks are expected to be completed very soon, and this should be of advantage to the stockholders, inasmuch as it would naturally have the effect of making the new securities much more marketable than the present sextet. The 7 per cent. preference changed hands

last Friday up to 41½; the preferred is quoted nominally at 11, and the deferred about 7. Metropolitan Electric Tramways 4½ per cent. debenture stock stands in the neighbourhood of 83, but has not been dealt in for a month; and the 5 per cent. debenture stock was last done at 81 about three weeks ago.

There is little that is fresh in the way of news from Mexico, though the various stocks and shares connected with the Republic are holding their prices with marked firmness. The three bull points in connection with Mexico are: (1) the official recognition of Carranza by the United States; (2) the work of the various committees formed to protect the interests of bondholders; (3) the probability of the currency question being taken seriously in hand. There is not much business doing in any of the stocks, but the undercurrent seems to be a firm one; and it is not easy to pick up the better-class bonds at anything like quoted prices.

The increase in the Shawinigan Water & Power Co.'s dividend from 6 per cent. to 7 per cent. had a stiffening effect upon the price, and, at the same time, has directed more attention to the issues of the Cedar Rapids Co.—more particularly the 5 per cent. first mortgage gold bonds—because the former company has a large interest in the latter, and is said to have been able to raise its distribution largely in consequence of the progress made by the Cedar Rapids concern. The 5 per cent. bonds stand about 92, with a coupon due on January 1st, so that the yield comes to about 5½ per cent. per annum.

The demand for bonds in the United States goes on increasing, and the securities of the best-class railroad undertakings are fetching fancy prices. Industrial bonds are also very firm. General Electric Co. 5 per cent. gold debentures have risen to 102½, and Shawinigan Water 5 per cent. first mortgage bonds stand at 104. Some of the others may be conveniently set out in a short table:—

Bonds.	Price.	Yield. £ s. d.
Consolidated Cities Light, Power & Traction 1st lien	77	6 9 6
Consolidated Gas, Electric Light & Power, of Baltimore, mortgage debenture	92	5 8 6
Mississippi River Power 1st mortgage	86	5 16 0
Pennsylvania Water & Power 1st mortgage ...	97½	5 2 6
Philadelphia Co. convertible gold debentures	95	5 5 0

The above bonds all carry 5 per cent. interest.

In the Canadian group, the Toronto Power Co. and the Winnipeg Electric Railway both have issues of 4½ per cent. consolidated debenture stock, standing at 85, the yield on which comes to 5¼ per cent.

The electric lighting list shows only one alteration, a rise of ¼ in City of London preference raising the price to 11, at which the return is just under 5½ per cent. on the money. There is some demand for County preference, and the preference shares of the other companies are not difficult to place, which is rather more than can be said of the ordinary shares.

Brazilian Tractions have fallen another point to 56½, the Rio exchange dwindling a little day by day. At the same time, Brazilian securities are by no means unpopular, and not much buying would be required in order to put a better appearance upon the Traction market. The preference shares are still difficult to obtain. Anglo-Argentine Tramways debentures are good, and there is scarcely any floating supply of stock. The 5 per cent. debenture stock is hard to get under 81; and evidently the speculative investor is attracted by the company's preference shares, for both issues are easier to sell than they are to buy. No changes have occurred in the British Columbia group. Victoria Falls ordinary shares are a good market at 7s. 9d., and the preference, at 18s. middle, keep steady.

Half-a-dozen rises attest the attention paid to the telephone market by reason of the excellent returns to be obtained from its leading stocks. Globe ordinary and preference are particularly firm. Eastern ordinary has gone up 3 points. Anglo-American deferred is steadily rising, and should touch 25 before long, if the present demand is maintained. New York Telephone 4½ per cents. are a trifle easier; and Marconi shares continue stagnant and neglected. There is very little doing in the shares either of the parent company or of its subsidiaries.

The manufacturing group as a whole is good, and British Westinghouse preference further improved upon their sharp rise of last week. In other cases, prices are decidedly firm, as the buyer finds when he attempts to pick up cheap stock. The rush in the rubber market is over for the time being, because the material went back to 3s. per lb. This has taken the glamour off the gamble; but, at the same time, every day furnishes its crop of good-class companies showing handsome dividends, and it is obvious enough that the results of the current year are not likely to fall behind those of the previous twelvemonth. In spite of the Excess Profits Tax, they ought in most cases to be substantially better. The armaments group is hardly moving, and copper shares are very quiet. The Broken Hill Mining group has received a strong impetus in consequence of the statement that the Australian Government has ordered that all contracts made with alien enemies before the war are to be regarded as null and void. This is considered tantamount to giving the various companies concerned with spelter, zinc, etc., the power to deal with their output independently of any fear of what might happen if, in doing so, they ran counter to the contracts which they had made previously with Germans and Austrians.

SHARE LIST OF ELECTRICAL COMPANIES.

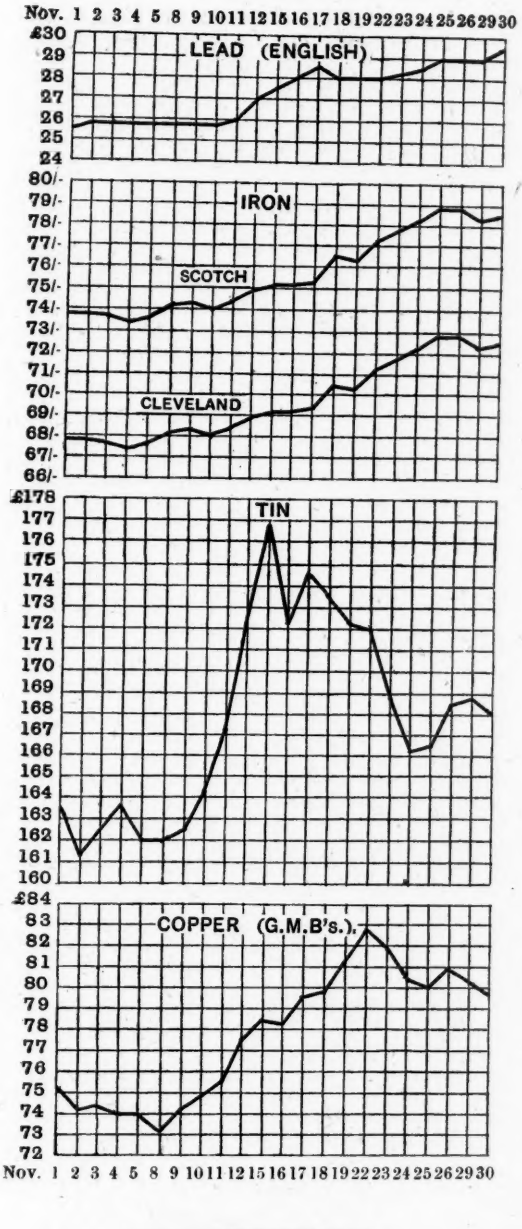
	Dividend, 1914.	Price Nov. 30, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3⅛	—	7 2 10
do. do. do. 4½ Pref.	4½	3⅜	—	6 0 0
do. do. City Pref.	4½	3⅛	—	6 8 7
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	+ ½	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	77	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3¾	—	6 0 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6⅔	—	7 13 10
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅞	—	6 19 0
South Metropolitan Pref.	7	1⅞	—	6 14 0
Westminster Ordinary	9	6⅔	—	6 18 6
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	102½	—	5 18 0
do. Def.	1½	22⅞	+ ⅛	6 11 3
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12⅛	+ ⅛	*6 12 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	+3	*6 4 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	+ ⅛	*6 9 2
do. Pref.	6	10⅜	+ ⅛	5 14 3
Gt. Northern Tel.	22	83½	—	6 11 4
Indo-European	13	46 xd	—	6 18 4
Marconi	10	1⅞	—	5 6 8
New York Tel. 4½	4½	101	— ¼	4 9 1
Oriental Telephone Ord.	10	1⅝	—	5 3 1
do. Pref.	6	⅜	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅜	+ ⅛	*7 19 1
do. Pref.	5	4⅞	—	5 2 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12½ xd	—	*6 8 0
do. 4 Deb.	4	80	—	5 0 0
Home Rails.				
Central London, Ord. Assented	4	71	+ ½	5 13 6
Metropolitan	1½	25½	+ ½	5 0 0
do. District	Nil	16	+1	Nil
Underground Electric Ordinary	Nil	88/9	— 1/16	Nil
do. do. "A"	Nil	5 9	—10½d.	Nil
do. do. Income	6	80½	+2	*8 10 5
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95 xd	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	8½	—	7 17 2
do. 4 Deb.	4	76	—	5 5 8
do. 4½ Deb.	4½	76	+1	5 18 5
do. 5 Deb.	5	80 xd	—	6 5 0
Brazil Tractions	3½	56½	—1	6 4 0
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	87	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	53	—	9 11 4
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	33	—	Nil
do. do. Deb.	4½	62	—	6 17 1
Mexico Trams	Nil	42	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	44	—	Nil
Mexican Light Common	Nil	30	—	Nil
do. Pref.	Nil	42	—	Nil
do. 1st Bonds	—	49	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	2⅝	—	6 1 9
British Aluminium Ord.	5	1⅞	—	4 14 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	10½	—	7 8 2
do. Pref.	6	5½	—	5 2 2
British Westinghouse Pref.	7½	87/-	+1/-	7 16 9
do. 4 Deb.	4	70	—	5 14 4
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	10½	—	7 2 10
do. 5 Pref.	5	4½	—	5 11 8
do. 4½ Deb.	4½	85	—	5 6 0
Castner-Kellner	20	8½	—	6 8 0
Edison & Swan, £3 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	57	—	7 0 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9½	—	6 6 4
Henley	20	12½	—	*8 19 4
do. 4½ Pref.	4½	4½	—	5 0 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	5	7⅞	—	6 5 0
Telegraph Con.	20	34	—	*8 1 6

*Allowance made for dividends being paid free of income-tax.

Patent Restoration. — An order has been made restoring Patent No. 24,539 of 1907, granted to Philip Francis Oddie, for "Improvements in duplex pumping engines."

METAL MARKET.

Fluctuations in November.



Heating Houses by Electricity in Sweden.—In Sweden, where the price of electrical energy is low, Hjalmar Lofquist, of Stockholm, is introducing an electric hot-water heating system for houses of four to 10 rooms. A thermally insulated water tank in which electric heating elements are installed is placed in the attic, and the water in this tank is heated at night, when the rates for electrical energy are low. In the morning the heating elements are disconnected by an automatic switch, which simultaneously starts a motor-driven water-circulating pump. Hot water is then conveyed through the pipes to the radiators mounted in the rooms to be heated, and thence it flows back through a common return pipe leading to a small tank in the cellar, from which it is pumped again to the upper tank. The circulation of the hot water is thus continuous. With a heat-insulated tank of 132 gallons capacity, and 4 KW. in heating units in operation 10 hours per day, it is claimed the water will absorb 74,800 calories, an amount of thermal energy said to be sufficient to heat four or five rooms. The cost of heating a room by this method with electrical energy at 1 cent per KW.-hour is given as about 12 cents for a normal winter day. By changing the number of electric heating units in service the system can be adjusted to weather conditions. The system is designed for use only where the cost of electric energy is low or where low rates can be obtained at night.—*Electrical World.*

ELECTRICITY IN AGRICULTURE: ITS NATIONAL ASPECTS.

For some time past more than the usual amount of attention in official circles has been devoted to the position of British agriculture, the necessity of increasing the production of food in the present crisis having become apparent even to the Board of Agriculture.

Expert discussion has centred on the question of ways and means, which are obviously to a large extent beyond the scope of an electrical journal—not wholly so, however, as we hope to show later on.

The problem to be solved is more involved than might appear at first sight; whatever methods are adopted must satisfactorily meet the conditions, not only during the uncertain period of the war, but after the war, when, no doubt, the competition of foreign produce will again be felt.

This points to the necessity of avoiding artificial stimulants and subsidies as far as possible, and of securing permanent alleviation of the conditions which have enabled wheat or meat produced thousands of miles away to come all that distance, and yet be sold at prices which apparently offer no inducement to the British farming industry to extend its operations. In a word, costs of production must be by hook or by crook come down to a lower level.

We think it will scarcely denied that the British farmer, despite the good work undertaken by agricultural colleges, societies, Chambers of Commerce, shows, and similar aids to advancement, is still in the mass unscientific, sceptical, unorganised, and, in fact, saturated with that John Bull cocksureness as to his own methods, which has in the past enabled British agriculture to survive, though not to progress.

One of the most important factors in production costs, viz., labour, has, judging by the literature on the subject, been gradually getting scarcer and correspondingly dearer, year by year, for some time; the war has at the moment added to the difficulty, for, as compared with January, 1914, between 15 and 20 per cent. of the agricultural employés have enlisted, and the bulk of them have not been replaced—and, in view of the probably increased cost of living for some years ahead, it is more than likely that the majority of these men, when ex-soldiers, will seek better-paid employment. In any case, the attractions of the town have always lured away the agriculturist, and as such attractions are increasing rather than decreasing, the labour difficulty, on that account, is likely to grow more acute.

In recent months farm labour has been deficient practically everywhere, wages have risen and temporary labour has been difficult to obtain; indeed, it is on record that farmers were recently giving up those productions which involved much labour, at a time, too, when an excess of home-grown produce is most desirable.

It is fairly obvious that labour is now, and will continue to be, the stumbling block to commercially and nationally successful farming in England, unless the logical solution to the difficulty, the introduction of scientific methods of labour saving on a large scale, is adopted.

A writer in a recent issue of the *Journal of the Board of Agriculture* points out that in the past, the introduction of farming machinery has always been intimately connected with labour supply, and that any abnormal migration of rural workers from the land has usually been followed by a large increase in the use of machinery. And since the outbreak of war the Board of Agriculture, more especially in view of labour shortage, has, in various ways, endeavoured to urge upon farmers the desirability of employing labour-saving machinery on the farm, attention having been particularly directed to the organisation of local demonstrations of machinery, towards which financial aid has been offered.

The Royal Agricultural Society has for many years been holding competitive trials of a wide range of mechanical appliances at its annual shows, with the specific object of developing the use of machinery and familiarising the farmer with its use; no particular attention appears to have been given either by the Board or the Society to the use of electricity on the farm, and we understand that the latter does not take the initiative in the intro-

duction of new processes, though it does what it can to promote the development of such processes.

It will be seen that both the Board and the Society have the desired end in view, but, excellent as no doubt are their intentions, we take leave to doubt whether their methods are in any way adequate to the present occasion, or, indeed, to the requirements of a national industry such as agriculture, in normal times.

To commence with, any system which encourages the farming community to multiply by tens of thousands, little explosion engines, of necessarily low mechanical efficiency, as sources of power, when there are within easy transmission distance public electricity generating stations able to supply both power and light, is economically unsound.

Why should we propagate inefficient methods of power supply in the case of farming communities around our towns, when in the towns themselves we are striving to eradicate this very same evil of small inefficient independent plants? It is undoubted that these little engines cost more to buy and to run than electric plant, and—considering the question from a national point of view—in the aggregate they represent the addition of millions of pounds annually to costs of production.

The answer is that a broad and comprehensive survey—a national survey—of the matter of the farmer's power, and, moreover, of what is equally important, his light, has not yet been undertaken by those who claim to watch over the agricultural welfare of this country; the potential resources of our electricity supply undertakings, in the matter of cheap power and light are not grasped, nor are the almost world-wide applications of electricity to farming, because of its economic advantages, appreciated in official circles.

The economic side of the question is concisely stated by an American writer in the *General Electric Review* as regards his own country, as follows:—

> **If the 25 or possibly 30 million horses and mules now used in farm work were displaced by mechanical power, 100 million acres of cultivated land would be released for human requirements, and it is safe to attribute the high cost of living to a very great extent to the very low efficiency of farm labour as compared to the higher efficiency in other industries whose rapid growth will continue to make even greater demands upon the farm productivity. The use of electricity on our farms is, therefore, sure to be greatly increased, and that this is becoming generally recognised by our central station interests is clearly demonstrated by the extensive network of transmission and distributing circuits which are being built and extended to cover the vast rural districts all over the country.**

The same writer in a paper read before the A.I.E.E. quotes the U.S. census figures of electrical motors driving agricultural implements as follows:—1899, 7,643; 1904, 20,713; 1909, 38,905; showing the enormous developments in this direction, although, no doubt, irrigation accounts for a good proportion of motors.

Another American writer mentions that over 125 farm uses have been found for electricity, and touching on the labour difficulty, he points out that electrical applications, even in their simplest form, bring great advantages to the farmer, not only in economy, but because they eliminate to a very large extent, the drudgery of farm life.

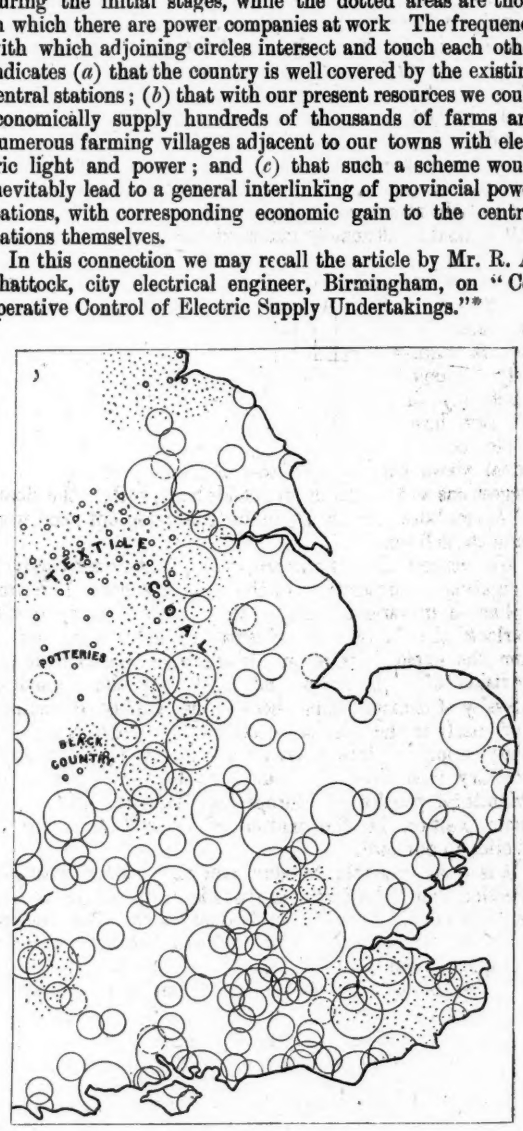
The hard work and long hours have made the farm labour problem a serious one. He considers that electricity, as much as any other one factor, will tend to alleviate or minimise the present drawbacks and check the migration of young men to the city, and that it will shorten farming operations and reduce the cost of them.

A reference to the map on this page will show that the principal agricultural areas of England are in great part within easy tranmission distance of a central station, but unfortunately the central station interests in this country have not recognised the great opportunity which undoubtedly exists for farm supply, nor do they appreciate the financial possibilities which such development holds out.

There are one or two exceptions, as shown in a recent article* in these pages, and in one case—the Hereford area—farming supply has reached a state of such proved utility, although only the initial work has been carried out, that it might well form the starting point for an official inquiry into the subject of agricultural electricity supply generally, having special regard to our own requirements in this connection, and the best means of meeting them.

In our diagram the larger circles of about 20 miles diameter indicate fairly large and generally alternating current power plants, which should find no immediate engineering difficulty in supplying the areas indicated; the smaller circles show the positions of direct-current generating stations, and give an idea of their possible range of supply during the initial stages, while the dotted areas are those in which there are power companies at work The frequency with which adjoining circles intersect and touch each other indicates (*a*) that the country is well covered by the existing central stations; (*b*) that with our present resources we could economically supply hundreds of thousands of farms and numerous farming villages adjacent to our towns with electric light and power; and (*c*) that such a scheme would inevitably lead to a general interlinking of provincial power stations, with corresponding economic gain to the central stations themselves.

In this connection we may recall the article by Mr. R. A. Chattock, city electrical engineer, Birmingham, on "Co-operative Control of Electric Supply Undertakings."*



Suggested Initial Agricultural Areas of Supply from Existing Generating Stations.

Mr. Chattock urged the vital necessity of dealing with the question of electricity supply to our industries on broad lines—in fact, on national lines, under Government control—when the country could be properly mapped out in areas, the boundaries of which would not be municipal or county, but arranged to suit the industrial requirements of the country as a whole; then overhead distribution could be developed on systematic and proper lines, and full advantage taken of the great economy in the cost of this method.

We quote Mr. Chattock's views on the greater question which he treated, as they necessarily apply to a widespread industry like farming, which can only be treated effectively as a whole, and in such a way as to obviate the present time-wasting official procedure and vexatious local obstructions, due to the necessity for obtaining wayleaves, and the possibility of a local authority vetoing the construction of an overhead line.

On all counts, the authority mostly concerned in facilitating our national interest in the matter of farming is the

* Electrical Review, June 11th and 18th, 1915.

* Electrical Review, December 19th, 1913.

Board of Agriculture, on whom should devolve the duty of initiating or approving suitable schemes of supply in selected areas, and, if necessary, of giving temporary financial aid in carrying them out in the way of short loans to municipal or other authorities, or to private syndicates in which farmers themselves might take an interest. The Board of Agriculture should exercise the same parental control over such schemes in the interests of agriculture, as, for instance, the Local Government Board does in connection with town planning schemes under the 1909 Act. Experience, both in this country and abroad, leads to the conclusion that the farmer is a profitable consumer of electricity, that he appreciates its labour-saving effect, the hygienic advantages of electric light, the increased safety and security from fire risk due to its use, and that the financial risk would be small. In any case such risk is insignificant compared with national danger of food shortage which the present crisis has brought so uncomfortably near, and the money would be well spent if it ultimately increased the productive capacity of the land.

Most of the great industries are carried on in the mass; the workers and thinkers are in daily and hourly contact, and the seeds of progress quickly germinate under such favourable conditions; moreover there is a collective body of opinion on the spot to help matters forward. Practically the opposite is the case with the agricultural industry, however, which, great and important as it is, as a whole consists entirely of scattered workers, whose individual views can only be co-ordinated by the systematic suggestions and efforts of an outside body, such as the Board of Agriculture, which is, in fact, carrying out good work along these lines.

We suggest that the Board, which is at present actively instigating demonstrations of the use of mechanical farming appliances in various parts of the country, cannot logically overlook the far greater advantages likely to be derived from the exploitation of our electric power resources in the provision of both power and light, nor the immediate necessity of demonstrating them to the farming community, particularly in the neighbourhood of towns where an electricity supply is already available. For it is imperatively necessary that England should not lag behind the other agricultural peoples of Europe and America, whose economic position in the matter of agriculture is already superior to our own.

It is quite possible to slur over the matter with the reflection that "the farmer is satisfied with things as they are." No doubt he is in individual cases. But the real question is are we, as a nation, satisfied with the position of our agricultural industry, as revealed by the war? and should we not adopt every available means of improving it?

THE FARADAY SOCIETY.

The Transformations of Pure Iron.

At its October meeting the Faraday Society held a general discussion on "The Transformations of Pure Iron." The discussion was opened by Dr. A. E. Oxley, of the University of Sheffield, who contributed a most suggestive paper, and the president, Sir Robert Hadfield, F.R.S., occupied the chair. Apart from the considerable number of experts present who dealt with the different aspects of the subject, contributions were received in writing from distinguished metallurgists in all parts of the country. We will endeavour here to summarise briefly the salient features of the discussion. The subject may to some seem academic and remote, especially in times of action like the present, but as the president pointed out, we must understand why certain treatment—alloying or heat treatment—can produce an adamantine form of iron, before we can really successfully manufacture hardened steel. The basis of this knowledge is an understanding of the properties of iron itself.

The experimental foundation for the view that pure iron can exist in different states is the occurrence of discontinuities in physical properties, and of well-defined heat evolutions in cooling and heat absorptions on heating at two if not three definite temperatures or ranges of temperature. Of these the more important are at a little below 800° C., known as the A_2 transformation from what is conveniently called the α to the β form, and the A_3 point at a little above 900° C., at which the supposed β form changes to the supposed γ form of iron. The A_3 change takes place, as far as our present data tell us, at a definite temperature, 915° C. on cooling and 935° C. on heating. The A_2 transformations do not occur at a definite temperature, but throughout a range of some 100° C. Changes in electrical resistance, thermo-electric properties and specific heats also take place at A_2 and A_3, but most striking of all are the magnetic changes which take place at A_2. Magnetisation begins to diminish appreciably far below the A_2 range, but near those temperatures it drops practically to zero. The question discussed at the meeting was: what is the nature of the internal changes taking place in iron that cause these discontinuities in physical properties; in particular, are they allotropic changes in the sense in which the change from oxygen to ozone is an allotropic change? Now this latter transformation is a difference of atomic structure in the molecule, and Dr. Oxley makes a clear distinction between this and the crystalline grouping of molecules. It has been usual to assume that the A_2 transformation, which, be it remembered, is apparently not a sudden but a continuous change, does not involve allotropy, it being merely a molecular redistribution, whereas the A_3 transformation is a true allotropic change. Dr. Oxley thinks the distinction unnecessary, preferring to explain the A_3 change, too, as a case of change in the crystalline grouping of the molecules, or a change in the closeness of the packing of the molecules, and not as in true allotropy, a rearrangement of the atoms in the molecule. In Dr. Oxley's opinion, the change from ferro-magnetic β iron to paramagnetic γ iron is consistent with such a view, because ferro-magnetism demands inter-molecular forces. A modification of these is all that is necessary to bring about the magnetic change at the transformation points. The fact, proved by Honda, that the magnetic changes are continuous through a range of temperatures is a strong confirmation of Oxley's views. Dr. Oxley was on more contentious ground when he looked for support to the small magnitude of the heat changes at the A_3 point, which he claimed were comparable with those of the fusion of elements rather than with ordinary allotropic misomorphic changes, for Dr. Desch showed that the heat evolution accompanying the change from grey to white tin—certainly an allotropic change—approximated to the heat changes in iron, and Mr. F. C. Thompson adduced the change from rhombic to monoclinic sulphur in support of the same contention. Prof. Pierre Weiss, author of the well-known "Magneton" theory, criticised from Paris Dr. Oxley's evidence from magnetic considerations. His recent work showed that β iron was probably Fe_3; that there were two varieties, one with 10 and one with 12 magnetons, and that γ iron was possibly Fe_2 with 40 magnetons. Dr. Oxley, however, maintained that these recent results of Weiss, which had been put forward at the Manchester meeting of the British Association, were proof neither of the atomicity of the different kinds of iron nor of the magneton theory, as he assumed the truth of one to prove the other. Very interesting were the considerations brought forward by Prof. Soddy, Mr. McCance, Prof. Carpenter, and Prof. Nicholson on crystalline structure, as it has been revealed to us by the X-ray photographs of the Braggs. This work goes to show that the conception of a molecule has no meaning as applied to a solid, because the atoms of the solid are anchored and do not exist in freely-moving groups (molecules) at all. Whether the groupings of the atoms in iron were monatomic or polyatomic, or whether there was a change at the transformation points could perhaps be tested by an examination of a well-formed iron crystal with the X-ray spectrometer. It was suggested that the President might be able to procure such a crystal and hand it to Prof. Bragg for examination. Dr. Oxley could not agree that the work of the Braggs precluded the conception of a molecule in the solid state. In the case of complex molecules it was possible to isolate a certain group of atoms in a crystal and say they belonged to a particular molecule. This aspect of the subject is obviously by no means clear, and the discussion will have justified itself by drawing attention to it. Other contributors to the discussion dwelt on the question of crystalline changes at the A_3 point, notably Mr. J. E. Stead, and Dr. Carpenter. Whether the transformation under discussion was called allotropic, or merely a difference in phase, there was certainly a profound internal physical breaking down and rebuilding of the crystalline structure, accompanied by an absorption of heat. Dr. Carpenter showed some slides illustrating the remarkable crystallographic changes that occurred within a range of 2°, when pure iron was heated for some time at 915° C. and allowed to cool. The consensus of opinion certainly seemed opposed to the view that these were mere differences in molecular packing, although whether the change is comparable to that from oxygen to ozone is equally open to doubt. At the end of it all the question remains an open one, but the discussion was certainly both suggestive and hopeful.

One remarkable fact of profound practical interest was mentioned incidentally by Dr. Harker. We have very few exact data on the thermal constants of pure iron. Although millions of tons of iron and steel are melted annually, we actually do not know exactly what the latent heat of fusion of iron is. This is work pre-eminently fit to be carried out at the National Physical Laboratory, and Dr. Harker outlined a method by which it should be attempted. Sir Robert Hadfield generously offered to defray the cost of the work if it could be carried out at the Laboratory.

Electric Smelting of Tin.—The Standard Smelting Co., of Pittsburg, has been organised with a capital of $100,000, and is erecting two Wile electric furnaces for smelting Bolivian tin concentrates. The company expects to be in operation very shortly, and the output at present arranged for is about 6 tons of tin per day. The product is expected to run 99·75 per cent. pure. —*Mining Journal.*

SOME DIFFICULTIES OF DESIGN OF HIGH-SPEED GENERATORS.

By PROF. A. B. FIELD, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *November*, 1915.)

In early days the limitations of speed imposed by the generator design acted somewhat as a handicap in the rapid development of the turbine, but recent years have witnessed a concurrent development of both turbine and generator, with the raising of the speeds of the combined sets to the limits corresponding to 2-pole and 4-pole designs. Simultaneously, the output per machine has been greatly raised, until many sets are now running capable of giving continuously up to 6,250 K.V.A. at 3,600 R.P.M., 20,000 K.V.A. at 1,800 R.P.M., and higher ratings at 1,500 R.P.M. (60, 50, and 25 periods).

In attaining these results many difficulties have been overcome in different ways, and the author describes some of the methods adopted by one large manufacturing concern in the United States with which he was connected for some years and whose engineering directors have been broad-minded enough to encourage such a discussion here. Reference will chiefly be made to a 20,000-KW. 3-phase machine having the following characteristics:—

Speed	1,800 R.P.M.
Poles	4
Cycles	60
Kilovolt-amperes	20,000 at P.F. 1.0 to 0.8
Voltage	13,200
Rotor dimensions	51 in. × 75 in.

About a couple of years ago some half-dozen of these machines were put in hand simultaneously, in addition to a number of other 2-pole and 4-pole machines of unusual sizes and proportions.

The design of such a machine represents to a greater degree than is usually the case a compromise between many conflicting mechanical and electrical requirements. Viewed in a general way, there is first the problem of constructing a rotor which must necessarily weigh something of the order of 60,000 lb., and which will be running with a peripheral speed in the neighbourhood of 24,000 ft. per minute. Such a rotor carries much metal which is not self-supporting. The centrifugal force acting upon a 1-lb. mass at the periphery will be about one ton.

Fig. 1 represents a cross-section of the steel of such a rotor when constructed from the point of view of mechanical stresses upon one of the simplest and most symmetrical plans.

Rotor Materials.—It is impracticable to use a through shaft with a hollow body or with disks threaded upon it—a construction, which, however, is satisfactory in smaller machines. The rotor body could be made as a solid steel casting or forging in one piece with the shaft ends, and it would be quite possible to obtain such a piece with a fair amount of

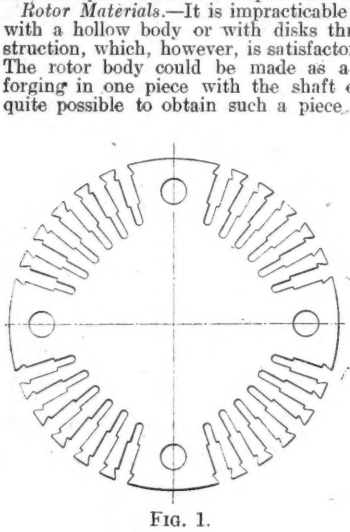


Fig. 1.

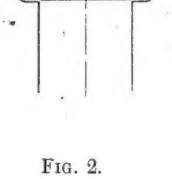


Fig. 2.

forging work done upon it; for example, an ingot diameter of about 6½ ft. would allow of a 2 : 1 reduction of area on the main section.

For lower speeds or smaller diameters such a construction is very often advantageously used. Such properties of the material as are desirable in the case of the larger machine in question are, however, difficult to obtain commercially. In many applications of forgings, bending and twisting effects have chiefly to be provided against; these involve longitudinal tensile stresses and shearing stresses, which reach their maxima at the periphery; ductility is chiefly of importance near the surface and in the directions indicated. Material near the centre is of no value, and is frequently removed by boring, so as to allow of better annealing conditions, and for other reasons. In our case, on the contrary, considerable *radial* tensile stresses are encountered, and the ductility in this direction is chiefly required far below the surface. Again, the radial tensile stress right into the centre is not inconsiderable, and were the central material removed by boring, the tangential tensile stresses, at normal speed, of the material near the bore would be in the neighbourhood of 20,000 lb. per square inch. To this must be added the local excesses due to such lack of symmetry as occurs.

Several large rotors, weighing up to some 45,000 lb., had been constructed successfully by the Westinghouse Co., of America, using two steel castings united on the rotor centre-line. Many experiments were needed before such castings could be produced with even moderately satisfactory qualities, and then only at considerable cost in discarded material and not infrequently in rejected castings. Ordinary carbon-steel, and also low-percentage nickel-steel had been used for these. At an early date in the use of these castings, the company had made elaborate tests by taking out several test-bars in different directions and at different radial depths in each of many sections, progressing from the top end to the bottom end of the mass as cast. Chemical analyses were made at corresponding points to trace the segregation occurring. In one such series of tests, over 100 test-bars were taken out of the casting, with a corresponding number of analyses. At a later date, tests were similarly made on a large forging, particularly to determine the properties in a radial direction and at different positions in the forging.

The construction initiated by the Westinghouse Co. for the large rotors under consideration was adopted after such investigations upon the regular market productions obtainable in the United States, and in consequence of realising that one must be prepared to build turbo-generators at all times, irrespective of market conditions (*i.e.*, when the steel mills are busy and therefore not anxious to devote extra and special care to the production of material of unusual properties to satisfy the requirements of critical inspectors), and that it is of great manufacturing importance to have designs such that the material may, as far as possible, be obtained from any one of many sources in the country. These are some of the more important reasons which influenced a decision in favour of the material and construction described below.

A difficulty, in some respects similar to that indicated above, had previously arisen in connection with large forgings for high-speed water-wheel-driven generators, and it had been overcome by the use of open-hearth rolled plates consolidated and mounted on a shaft. There is probably no other form in which such large masses of steel can be produced at a low cost having such good physical properties in directions of two dimensions.

In the case of a number of important machines Behrend used the thickest rolled plate that was commercially available; this would limit us generally to plate about 2¼ in. thick in the rough. One batch of about 100 tons of such steel produced under unusually favourable conditions and containing a small percentage of nickel, gave tests averaging approximately as follows:—

Ultimate tensile strength ...	80,000 lb. per sq. in.
Yield point	53,000 lb. per sq. in.
Elongation	26 per cent. in 2 in.
Reduction of area	60 per cent.
Bending test	Strips the full thickness of the plate bent through 180 deg. and closed down without fracture.

In the case of the steam-driven turbo-generators under consideration, this plate material appeared very attractive, combining, as it did, a very low cost per pound with entirely reliable properties from the periphery to the centre and from end to end of the rotor. Its use would result in the production of a rotor in which practically the only internal stresses would be intentional ones; there would be nothing corresponding to the huge initial stresses to which solid forgings and castings are liable. With the plate construction every cubic inch of material would be within an inch or two of a forged surface (or the equivalent). The impossibility of using a central shaft, however, at first discouraged the idea of a build-up plate rotor. It was due to the suggestion of Behrend, again, that the feasibility was demonstrated of constructing such a rotor with the plates slightly rabbeted into one another, and into a flanged shaft at each end. A rabbet about ½ in. deep is ample; and by means of a group of four or six chrome-nickel steel bolts, each about 4 in. in diameter, a 50 to 56-in. diameter rotor can be constructed with practically the solidity of a single piece. These bolts can be tightened up until they have a stress of about 40,000 lb. per square inch, and in the actual construction of the rotors special means are adopted to ensure obtaining a tension in the bolts roughly corresponding to the desired amount, by tightening the nuts until a specified elongation of the bolts has been attained, the elongation being a distinctly measurable amount, viz., over 1/10 in. in many cases.

Another method that had been in use for some time in similar operations consists in applying the required force to a 5-ft. or 10-ft. spanner by means of the shop crane. Using a regular suspension weighing machine on the crane hook, this force can be measured, and hence the final tension in the bolt determined, provided it is known what coefficient of friction should be allowed with respect to the rotation of the nut. Comparing the two methods, and from other direct means of check, it was found that a coefficient of friction of about 0.16 suited the conditions of lubrication. The crane-and-weighing-machine method has some advantages in prac-

tical operation over the extension method, and it has been generally used.

It is still necessary to have heavy forged shafts with large flanges forged on them, of the full diameter of the rotor; however, the difficulty of securing a satisfactory forging has not only been reduced as the consequence of the much smaller weight of each single-piece forging, but the axial length of the large-diameter part can be kept down to such dimensions that in addition to the usual radially-directed forging process, the material can be worked in an end-wise, *i.e.*, axial, direction. This method of working the material ensures good properties in a radial direction. In other words, to produce the flanged shafts for the severe cases under discussion, a large bloom is forged down to a diameter intermediate between that of the flange and that of the large end of the shaft, and stepped off; the forging is then placed with its axis vertical, in a die, under a forging press, and the increased flange diameter obtained by end-wise forging. Radial test-bars taken out of the flanges of such pieces, even at a depth of 8 or 9 in. from the surface, have shown excellent results; one can practically depend upon getting an elongation of over 20 per cent. in 2 in., with a reduction of area exceeding 35 per cent., in a standard ½-in. test-bar from a carbon-steel forging, giving an ultimate tensile strength of 70,000 lb. per square inch and a yield point of 35,000 lb. In fig. 3 is shown a partially-machined shaft produced in the way described.

When the plates can be obtained locally it is frequently convenient to use ingots of such size that one disk is obtained out of each plate, so that the complete plate can be delivered to the factory, put upon a boring mill, and the required disk parted out of it, the scrap material being returned to the rolling mill. In this way, incidentally, we have an easy check upon the amount of discarded material from the top and bottom ends of the ingot; and we save the shearing labour, and also the machining of a considerable radial margin which must be left when the plates are rough-sheared to circular shape at the mills.

The plate can easily be supplied flat enough for a ¼-in. allowance to be sufficient for machining both sides, especially as the diameter of the rabbet projection on one side of the plate is only about half that of the plate itself.

Whether the material is supplied sheared or in the rectangular plate, it is marked by the rolling mill to indicate the part corresponding to the top end of the ingot, and care is always taken to transfer this mark while machining, so that a corresponding indication appears on the finished plate. When drilling and assembling the plates, this marking enables us to rotate each plate, say, 60 deg. with respect to the plate below it in a constant direction, so that in the complete rotor there is practically no remnant of the slightly different properties of the plate in directions along and across the direction of rolling.

The properties which can be expected from this material as an average are somewhat as follows:—

Ultimate strength	67,000 lb. per sq. in.
Yield point	34,000 lb. per sq. in.
Elongation	27 per cent. in 2 in.
Reduction of area	43 per cent.

For a cold bending test, a strip of the full thickness of the plate will generally bend through 180 deg. round a 3-in. diameter pin. For purchasing specification purposes, it is necessary to allow some margin on these figures, particularly in the matter of ductility. As regards the market price, this is in the neighbourhood of 0.8 to 1d. per lb. with ordinary conditions of the steel market.

Critical Speed.—While many large rotors are running satisfactorily at operating speeds above their critical speeds, it is believed that there is a distinct advantage in keeping the critical speed above the running speed, when this is feasible. Experience has shown that in the case of some 4-pole machines of the former class, running perfectly under normal conditions, a short-circuit of even a few turns of rotor winding on one pole may result in serious vibration. On the other hand, one of the machines now under discussion and designed for a high critical speed, was purposely run with two-thirds of the winding of one pole short-circuited, and no considerable difference in the running was noticeable.

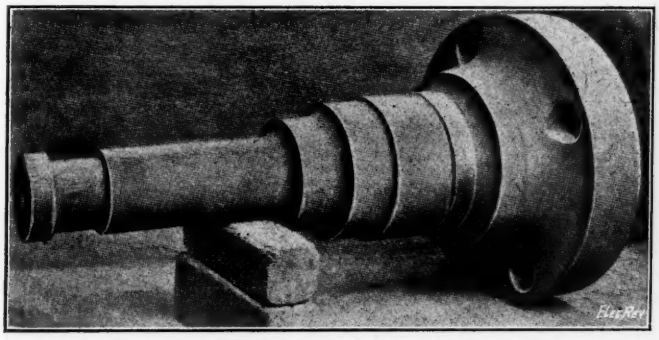


Fig. 3.

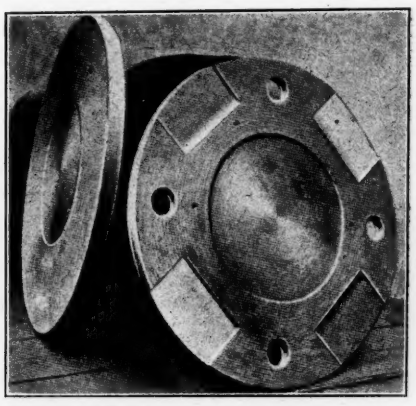


Fig. 4.

If it is decided to run below the critical speed in the case of these large machines, concessions must be made in nearly every feature affecting the critical speed. The rotor body must be as short and light as possible, involving a high air-gap density and a severe working of the stator material in the neighbourhood of the air-gap The shaft diameter must be kept large, and high peripheral speeds must be tolerated for journals and slip-rings. In the case of the present machines, the journal speed approaches 6,000 ft. per minute; and for the slip-rings a speed of about 11,000 ft. per minute becomes necessary, even after adopting special means to keep the slip-ring diameter as small as possible, short of using a hollow shaft and slip-rings outside the bearings. The span between the journal centres especially must be kept small, which imposes some limitations upon the design of the stator end-windings, and necessitates the omission of blowers from the rotor. The lengthening of the rotor span, entailed by the use of blowers on the rotor, is greater than corresponds to the axial length of the blower openings on account of the provision that has to be made in the end-bells, and the necessity of being able quite easily ot dismantle the end-bell structures without disturbing other parts of the machine.

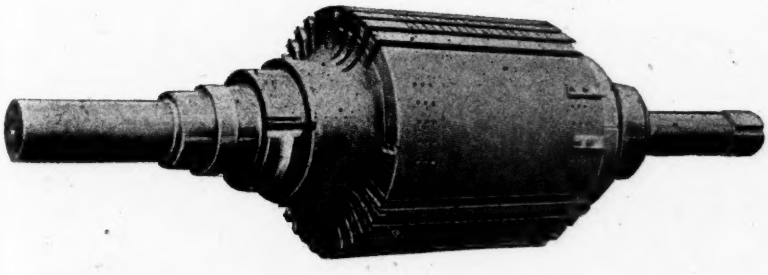


Fig. 5.

In this connection it is of some interest to notice that a rotor constructed along these lines really has no true critical speed.

Rotor Ventilation.—It is extraordinary how large a rotor loss can be dissipated merely from the drum surface with no ventilation, and it is commonplace knowledge how little good some fairly elaborate ventilation systems are found to do.

Nevertheless, it is possible to obtain very efficient ventilation, and our object of obtaining a small, short rotor can only be attained by taking advantage of every means to that end.

It therefore becomes incumbent upon us to use a ventilated rotor and to put up with the disadvantage that this necessitates cleansing the air supply before admission to the generator. In any case, the disadvantage is not so great as at first appears, inasmuch as the stator gains a great deal of benefit at the same time from the absence of dirt.

The system of ventilation which lends itself best to the other features of the machine that we shall have to adopt, is one combining an axial passage underneath the winding slots with a radial discharge distributed over a fairly wide central portion of the rotor. The plate construction here lends itself admirably to our requirements, inasmuch as we can readily obtain the radial ventilating spaces by means of a simple "slab-miller" operation upon the individual plates before assembly. This provides a vent $\frac{3}{8}$ in. wide in the region of the slots and teeth, leaving the plate solid in the region of the pole. Were the rotor made of a single piece, the radial vent space could only be obtained reasonably by parting down grooves round the complete circle. The previous arrangement not only gives a very solid rotor by having the plates butt together up to their outside radius, but also the extra metal in the region of the poles is needed for magnetic reasons. The size of these rotors for their output is such that we begin to get some saturation in the poles, a condition rarely occurring in general in the case of 2- or 4-pole turbo-generators, except when artificially obtained.

Fig. 4 shows a pair of disks for a 4-pole rotor; in this particular case the disks have been parted out of the rectangular plates. The one disk is ready for assembly, having been milled on one side for the ventilation in the slot region, but the other disk has only been faced. After assembling the disks and shafts, the bolt-holes are to be reamed out, the bolts fitted, and the winding slots cut. The bolts are to be finally tightened after the slotting, and the heads of the nuts cut off. Fig. 5 gives a general idea of a 2-pole built-up rotor ready to receive its windings.

Rotor Windings.—A separately-formed edge-wound coil, dropped turn by turn into the slots, is used, with solid mica insulation and a light steel cell to protect the insulation against the effect of the ventilating air. For several mechanical reasons, concessions are made in the electrical requirements of the winding, so that a comparatively wide strip (about $1\frac{1}{4}$ in.) is used, with only three coils per pole, *i.e.*, six slots per group, in the 4-pole rotor. The field windings, even when of this width, will be of substantial thickness, perhaps 0.1 in. for 220-volt excitation, and it is not altogether an easy matter to get such windings down solidly in the slot in such a way that no shifting will occur during running. It must be remembered that the pressure of the coils upon the wedges in such a rotor when running at 20 per cent. over speed exceeds 200 tons for each slot. It is hardly possible to put this pressure upon the winding during construction, but fortunately it seems that by a suitable succession of applications of considerable pressure, with baking processes interspersed, the further yielding of the windings with increased pressure is small, and quite good results can be obtained, even when the pressures put upon the copper during construction do not reach those which will occur during the over-speed test. Even so, special shop equipment is needed to press the windings into the slots in the way indicated above. Finally, it is important that the retaining wedge should be put into position while the coil is still under considerable pressure. This, however, is almost impossible if it is attempted to drive the wedge over the top of the coil in an end-wise direction. The wedge construction shown in fig. 2 is very effective in overcoming this difficulty, inasmuch as the central bronze part of the wedge can be inserted in the slot and pressed down upon the winding under great pressure while the two steel liners, one on each side, are driven into place without any friction on the top surface of the insulated coil. While this mechanical feature of the 3-part wedge is important, there are also electrical advantages. On account of the high air-gap density, the size of air-gap is small for machines of this class, being of the order of 1 in. radially. In conjunction with such an air-gap, the width of rotor slot required to accommodate a $1\frac{1}{4}$-in. copper strip would introduce a considerable extra stator-tooth loss, due to the pulsation of flux in the tooth as the rotor slots and teeth pass underneath it. By the 3-part rotor wedge construction, the opening of the rotor slot is, from a magnetic point of view, greatly reduced, and a reasonable compromise is thereby effected. Oscillograph tests to investigate this matter have been taken, by using an exploring coil round the top of one tooth of the stator, and such records were obtained both at no load (full voltage) and under load conditions.

(To be continued.)

Discussion in London.

Prof. S. P. Thompson, in opening the discussion, said the author dealt with the practice of a particular firm. One could not so well realise the actual conditions from a description; it was necessary to see the construction. He asked, was it a fact that the built-up rotor with $2\frac{1}{2}$-in. core disks was as stiff as the solid rotor? He confessed to some doubt as to the bolts which had to brace together so many joints; but possibly experience confirmed the value of this type of construction. He asked why the bolt heads were cut off, as it would seem better to leave them on. The 3-part wedge was admirable; he presumed the end rings described took the place of the bells formerly used for retaining the end windings. The paper hinted at the supersession of mica by fused silica for stator insulation, which would be a great advantage. He asked what was the merit of the 60-cycle standard largely adopted in America, and how it worked out in practice, and concluded by remarking on the contrast between the machine described and the 50-year-old alternator in the Institution collection.

Mr. F. H. Clough remarked that it would be an advantage to have definite ratings and no ambiguity as to overloads; under English rating, the 20,000-kw. machine referred to by the author would be called a 14,000-kw. machine. The use of initially stressed rotor bolts was ingenious, but probably the same result could have been obtained by other constructions. He thought it would be possible to use a through construction, and that much larger holes could be obtained for ventilation and more copper be put on. Judging from the description, he believed the machine would have been cheaper if it had been designed with considerably less flux and higher armature reaction. Close regulation was not aimed at, and there seemed no reason why a high flux should have been used. The machine could also have been built to run satisfactorily through the critical speed, and it would have been possible to retain the rotor fans rather than provide external apparatus. He was not quite in favour of the three-

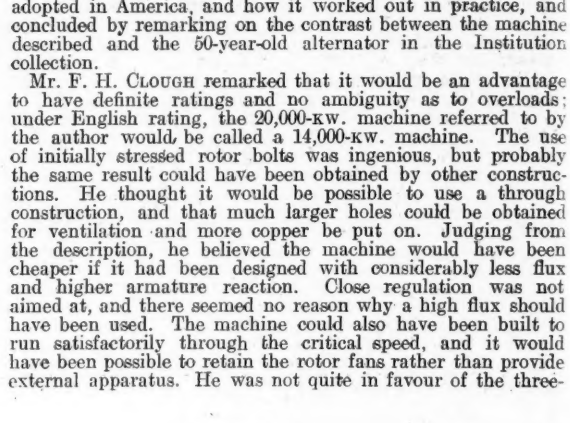


Fig. 6.

part wedge, and thought a one-part wedge would have been sufficient. It was almost unnecessary to adopt the refinement of inlaying copper on the end rings if the bonding of the rotor was thoroughly carried out.

Mr. H. Burge said the rotor construction appeared to give no positive means, except for the copper in the slots, of preventing the core plates sliding one on the other, and giving rise to torsional movement. The slot wedges shown must be very useful in preventing eddies in the solid pole faces. As regarded eddies in the stator conductors, the usual cure in deep slots was to use a pressed stranded conductor and solid end connections.

Dr. Smith pointed out that the same difficulties did not arise here with 50-cycle machines as was the case with the 60 cycles adopted in America. The whole argument as regards the construction adopted seemed to be based on obtaining a rotor to run below the critical speed. If one could build a rotor to run satisfactorily between the first and second critical speeds, then it would obviously increase the limit of output considerably. But if the limiting speed was below the critical speed, it would limit the output, and it seemed that had already happened. If it was required to double the output, he thought it would be impossible to run below the critical speed. The built-up type of rotor construction shown seemed repugnant to him; the suggestion occurred as to whether through bolts could not be used with a solid rotor construction; he thought the conditions would be no worse, and might be better. He asked what was the value of the stator leakage on such a machine. He was glad that the author favoured making the machine itself safe against short circuit and did not rely on reactances. The 2-pole construction seemed rather clumsy; the wedge arrangement was ingenious, but he questioned whether it was necessary to use so much bronze in the wedges, and suggested the possibilities of cast-iron as a material which was cheap and easy to work, and would provide a semi-magnetic closing of the slot. There might be some throttling of the flux in the rotor, owing to the bolts, which would be reduced in section by the initial stress put on them and be a loose fit.

Mr. W. M. Mordey supported the author's contention in favour of building machines which could be dead short-circuited at their terminals when running excited and giving full voltage. This requirement should appear in every specification. It was wanted not only for the generator, but also for

the turbine, and the test should be made with full load on as it might occur in practice. This test should be a condition of final acceptance.

Mr. R. Livingstone said it seemed that the time had not yet come for us to face the problems dealt with by the author. Such large machines could not be employed in our stations under the conditions obtaining here. We were dependent on the metallurgist for progress in output, and there would be no difficulty if the materials were available. He gathered that the type of stator conductor used was a twisted one; the ordinary method was to use a stranded conductor. Many people favoured the use of rotor fans which added to the rotor length, but with big stations, separate air cooling and filtering plants would be necessary. It was very doubtful whether it was necessary to use magnetic steel for rotors, and probably ordinary steels would be quite satisfactory.

Mr. R. F. Allen considered that the method of obtaining initial tension on the rotor bolts was rather crude, and suggested that the core plates could be squeezed hydraulically and the bolts then tightened.

Prof. Miles Walker, in a written communication, said: the construction of the steel body of the rotor described in the paper is very suitable where rotors of large diameter are required to run at high speeds, say, at a peripheral speed of 24,000 ft. per minute; on a rotor running at 1,500 r.p.m., and not measuring more than 50 in. in diameter, it would appear that satisfactory solid forgings can be obtained. As the present tendency is to build larger and still larger units, it is well that we have this steel-plate construction described in the paper, so that the peripheral speed can be still further increased without introducing an element of uncertainty. In regard to rotor windings for small machines and for machines of medium output, the separately-formed, edgewise-wound coil shown in the paper has been found simple and convenient; but I believe that for the very much larger machines which are to be built in the future a better type of winding should be put forward. Such a winding is already in use in a large number of generators having a rating of 4,000 kw. and over; the heavy end-windings are supported in a thoroughly mechanical manner between stout steel cheeks; while the copper in the rotor slots consists of deep bars, so that there is very little insulation to give way. The diameter of the rotor for a given output can be considerably reduced. To illustrate the advantages of this winding, fig. 6 shows a lay-out of the end-connectors for a 50,000-k.v.a. generator running at 1,500 r.p.m. The diameter of the rotor is only 58 in., so that the steel body can be built up with steel plates, as described by Prof. Field, and the stresses would be less in it than in the 20,000-k.v.a. machine described in the paper. The main weight of the end-connectors is taken by the steel cheeks marked vv; the total stress in these cheeks due to the copper load and their own weight does not amount to more than 11,500 lb. per square inch. There are 88 slots, and 6 bars per slot, each bar being skewed over through a distance of 1½ in. as it comes out of the slot, so as to admit of expansion and contraction. It is found that owing to the extremely good ventilation of the parts of the bars which project from the slots, the copper section can be cut down to about one-half, and this gives plenty of room for the steel hoops which support them. The total stress in these hoops is not more than 19,500 lb., and the factor of safety of the whole construction is a little over 6. The electrical connection between the end-connector and the bar can be carried out by electric welding at the point w. The method of pressing down the coils by means of the wedge shown in the paper is very ingenious, and overcomes what otherwise is a serious difficulty. The paper is a valuable record of some of the steps which have been taken towards that great desideratum after the war—the cheap supply of electrical power.

The Author, in replying, said they could get no manufacturers in the States to supply the large forgings which would be required; there would be enormous initial stresses in such structures. He thought the running tests had proved the stiffness of the rotor construction employed; no critical speed had been discovered. The nuts were cut off the rotor bolts because smooth ends were required. A periodicity of 50 cycles seemed to be desirable; 60 cycles was advantageous to the turbine because of the increased steam speed; it was found cheaper to build 500-kw. turbines running at 6,000 r.p.m. geared to 900 r.p.m. generators. The practice followed in the paper and in America was to rate the machine at what it had to do. A large rotor could be built with a through shaft, using chrome-nickel steel disks, if one cared to pay the price. The machine described was by no means a high flux machine, but it was a high density machine, because short—the size was small for the output. The feeling in the States was that the external fan had distinct advantages. An ordinary pressed stranded stator conductor did not get over the trouble of eddy currents: only a thoroughly interwoven stranding would do this. While it was possible to build machines to run below the critical speed they would do so, but if necessary they would go above it. Through bolts would not render a solid rotor construction safer in regard to radial stresses. With the 2-pole built-up rotor, six bolts were used, two at each pole and one each at an intermediate place; the bolt space was waste, and the only available place was between groups of windings. Bolt clearance spaces were of no account when dealing with the large air gaps used in such machines. Nickel steel was used quite largely for rotor bodies in the States. He believed that the large turbine units would be required in this country just as much as in the States.

THE ELECTRICAL INDUSTRY AND THE WAR.

Mr. David A. Starr, the new Chairman of the Scottish Local Section of the Institution of Electrical Engineers, opened the session in Glasgow on November 9th with his inaugural address. He said that it was a source of the greatest gratification to those who had assisted in the adaptation of electricity to many useful purposes, that electricity was playing such an important part in the successful carrying out of the war. The many applications of electricity on war vessels, from the super-dreadnought to the submarine and mine sweeper, were now so important that without this agent our Navy could not maintain its place in defending our shores nor hold supreme command of all the seas. It had been frequently represented by the military and naval authorities that this war could not be carried to a successful issue without the thorough co-operation of those who were engaged in the manufacture of war munitions; electricity, probably more in this branch of war activities than in any other, had played a great part in facilitating the rapid turning-out of work, and it had undoubtedly been to the advantage of the nation that, in practically all the great shipbuilding centres, all extra and urgent power requirements had been expeditiously met from local central stations. There was no doubt in his mind that in the public electric supply of the country the nation had at this critical period an asset of the first importance, and those who were interested in this work felt that they were assisting in safeguarding the freedom of Europe from the yoke of German militarism. A very important matter in which the management of all generating stations was interested to-day, whether municipal or otherwise, was the cost of production. There were two items which entered very largely into such cost, namely, coal and labour. On comparing to-day's prices with those of 1911 and 1912, the increase in the cost of coal was nearly 100 per cent. in the West of Scotland. That increase, due very largely to conditions arising out of the war, was fortunately checked to some extent by the Government passing an Act which limited the price of coal to the consumer, and by recent legislation affecting the exportation of coal. The remedy that power producers had was to insert a coal clause in their contracts with consumers, and that had been almost universal practice during the last few years. The terms of the coal clause varied in different parts of Great Britain, the general practice, however, being to arrange as a basis a fixed price per ton delivered to the power house, and to adjust the price per unit to the consumer in proportion to the increase or decrease of fuel cost per ton. In some cases a fixed price for a standard coal at the pit mouth had been taken, the intention being to guard against an abnormal rise in the price of coal. The second factor which entered so largely into the cost of production was labour. Most power producers had had to concede additional wages, generally in the way of a so-called war bonus to employés on account of the increased cost of living, and this was a factor which must be reckoned with at the end of the financial year. Many electrical undertakings had not been interfered with to any very serious extent by the action of labour agitators, but he was sure that all true patriots would have welcomed, either at the time war was declared or shortly afterwards, a Royal proclamation, putting every man, woman, and child in the country under martial law. He did not wish at present in any way to censure those who had the control of such affairs, but, at the same time, he could not help but think that some of those in authority had still a tendency towards political jobbery rather than the promotion of the highest national interest by the exercise of sound commonsense. It was almost certain that when the war was over there would be a reduction in the supply required for munitions work, a great deal of which must necessarily be of a temporary character, many contracts having been made for the duration of the war only. It would take some time to re-organise industrial works which were temporarily equipped for this class of work, and to restore their plant to normal industrial capacity. On the other hand, it was quite possible that a great many manufacturers would find new markets for their products, both at home and abroad. During the period of the war their shipyards had been almost exclusively engaged on war material. A great many ships had been rendered useless for their original purposes through being stripped of their fittings and converted into armed cruisers, transports, etc. The shortage of merchant ships consequent on German submarine activities must to some extent be made up. It was, therefore, reasonable to expect that shipbuilders and a great many engineering concerns who depended on the subsidiary work in connection with both naval and mercantile shipbuilding and ship repairing would be exceedingly busy. The restrictions placed on the export of coal would be withdrawn, and the output of the collieries should be consequently increased. Opportunities would be afforded to British manufacturers to obtain a firm footing in markets all over the world which had hitherto been entirely in the hands of the Germans, and if these opportunities were grasped an increase in the number of industrial factories might be looked for. Naturally, money to finance new projects would be both

scarce and dear, but, making allowance for this, they should be in a better position than their enemies or allies. This was a subject which should engage the most thorough consideration and careful attention of the personnel of the electrical industry in common with all other British manufacturers. They must face the future in a spirit of calm optimism, and with Britain fully awakened the recapture of their former world trade by the Germans should be a "negative possibility."

INDIAN NOTES.

[From our Special Correspondent.]

Electrical business in India keeps fairly brisk, in spite of the serious and unavoidable delays over delivery of supplies from home. Prices have, of course, gone up in proportion to the home manufacturers' increases, plus the freight and insurance extras. The Government since the beginning of the war have bought all available self-contained lighting sets, especially those suitable for searchlight work at ports and harbour entrances. All available telephones of the field type, too, have been bought up. Arc lamp carbons are practically unobtainable, and in very many instances arc lamps are being supplanted by half-watt lamps for outside lighting purposes. Odd and old stocks of electrical supplies are being cleared out from contractors at good prices, and the familiar 10-in. opal shade is becoming a scarcity indeed. All stocks of motors and dynamos are practically exhausted by now, with no hope of replacement within what used to be considered a reasonable period.

Bhavanagar.—This wealthy native State has recently had a specification drawn up by the Lahore Government Electrical Inspector for an electrical plant for palace, house, and street lighting. Not many firms tendered, although the specification was a reasonable one—in fact, only a few select firms were invited to quote—so that the successful tenderer should get in at a rate to secure a handsome return.

An Electrical Conference.—An important conference of electrical inspectors and engineers in the service of the Government was opened in Calcutta on November 1st. Mr. J. W. Meares, electrical adviser to the Government of India, presided. The *Pioneer* states that the conference was convened at the suggestion of the Government of India with the concurrence of the Provincial Governments. We are indebted to our contemporary for the following summary of the opening remarks by Mr. Meares:—

Mr. Meares in the first place remarked that that was the first conference of its kind, and hoped it would be followed by many more held annually, and he then went on to bring before the conference the various questions which were down for discussion. The first of these had reference to rules relating to electricity in mines. Mr. Meares had prepared a rough draft based on the British Home Office rules, and intimated that as a result of the conference and his consultation with the technical advisers of the Indian Mining Association, he hoped to prepare a revised draft, which, after it had been put into legal shape, would, he trusted, meet with general approval when formally published for criticism. Mr. Meares then turned to the Electricity Act and the rules under it. He referred to the early legislation concerning electricity in England and restrictions thereby imposed upon a great industry, and went on to express his belief that the electrical industry in India had not been seriously handicapped by defects in the law. He emphasised the fact that the rules in force under the Indian Act could be relaxed when it was necessary, and added that it remained for electrical engineers and inspectors to use the power of relaxation for the good of the industry while safeguarding life and property. A matter he had lately to discuss was that of the so-called compulsory clauses of the Electricity Act. Outside capital had always been shy in India, and would be more so in future, while the secret of unlocking the vast supplies of indigenous capital had only to a small extent been solved as yet. He was told that one of the chief causes of that shyness, so far as electric supply to towns was concerned was the fear of the specification in licences granted of compulsory works in streets where no return was likely to be secured. On this point Mr. Meares declared, "If compulsory areas hinder enterprise, then, in my opinion, compulsory areas should be severely limited or altogether banished, and I believe this view will be generally accepted." Mr. Meares next turned to questions concerning installation work, and on this subject he said he did not suppose it was possible, or even desirable, that there should be rigid and uniform specification for electrical wiring all over India and Burma. At the same time, he said it might assist contractors who had branches all over India if the conditions to which they tendered, and the material they had to supply, were more or less the same everywhere. "There are boundless possibilities in connection with electricity in India," Mr. Meares said in conclusion, "and as yet only the fringe of them has been touched. We can do a great deal of good or harm according to the way in which we tackle problems which come up to us."

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,094. "Wave transmission." G. Constantinesco & W. Haddon. November 15th.

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16,107. "Dynamo-electric machines." E. Girardeau. November 15th. (Convention date, November 16th, 1914, France.) (Complete.)

16,112. "Ohmmeters and like electrical measuring instruments." H. E. Trent. November 15th. (Complete.)

16,113. "Wattmeters and like instruments for the measurement of electrical power." H. E. Trent. (Complete.)

16,118. "Sparking plug." R. M. Alexander. November 16th.

16,145. "Valves." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 16th.

16,149. "Arrangements for phonographically recording and reproducing telephonic messages." F. Seelau & A. M. Newman. November 16th. (Convention date, December 5th, 1914, Germany.) (Complete.)

16,151. "Wireless telegraphy." Marconi's Wireless Telegraph Co., Ltd., and R. D. Bangay. November 16th.

16,155. "Means, such as glands or grips, for the cables of electrical apparatus and the like." E. A. Graham. (Complete.)

16,176. "Masts for wireless telegraphy." E. L. Peacock & Swan, Hunter and Wigham Richardson, Ltd. November 16th.

16,184. "Switch-holders for electric lamps." R. M. Neilson. November 17th. (C. C. Gordon, Portuguese East Africa.)

16,185. "Electric insulators." A. R. Muller. November 17th. (Addition to 27,738/12.)

16,207. "Telephonic transmitters." E. A. Graham. November 17th. (Complete.)

16,270. "Electric arc lamps." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 18th.

16,271. "Magnetically-operated prime mover." W. H. Higgins. November 18th.

16,281. "Wave transmission motors." G. Constantinesco & W. Haddon. November 18th.

16,290. "Portable electric battery lamps." Bernard Pordes. November 18th.

16,336. "Electro-deposition and extraction of zinc." U. C. Tainton and J. N. Pring. November 19th.

16,345. "Electric safety devices." British Thomson-Houston Co., Ltd., and H. N. Sporborg. November 19th.

16,349. "Electric incandescent lampholders." C. G. M. Bennett. November 19th.

16,364. "Arc lamp electrodes." Planiawerke Akt. Ges. fur Kohlenfabrikation. November 19th. (Convention date, December 31st, 1914, Germany.) (Complete.)

16,379. "Electric couplings." E. C. Goad. November 20th.

16,389. "Electric light fittings." W. H. Derriman. November 20th.

16,393. "Loaded line system." Western Electric Co., Ltd. (Western Electric Co., U.S.A.) November 20th. (Addition to 12,434/15.) (Complete.)

16,395. "Electrical switches." A. C. Wynne. November 20th.

16,402. "Electric signs." H. F. Lowenstein. November 20th. (Complete.)

16,408. "Magneto-ignition systems." Etablissements de Dion-Bouton Soc. Anon. November 20th. (Convention date, September 6th, 1915, France.) (Complete.)

PUBLISHED SPECIFICATIONS.

1914.

20,319. Line or Wireless Telegraph Systems. W. H. Shephard & A. F. McKechnie. September 29th.

21,792. Electric Meters of the Thermal Type. P. M. Lincoln. October 30th. (November 5th, 1913.)

22,554. Art of Duplex Telephony. British Insulated & Helsby Cables, Ltd., W. P. Fuller, and H. H. Harrison. November 14th.

22,887. Telephone Receivers. J. W. Greenwood. November 23rd.

23,071. Electric Measuring Instruments of the Moving-coil Type. F. Holden. November 25th.

23,357. Electric Starters, more particularly for use on Motor Cars and the like. A. H. Midgley & C. A. Vandervell. December 1st.

23,544. Electro-magnetic Switches. British Thomson-Houston Co. (General Electric Co., U.S.A.). December 4th.

24,697. Electric Connecting Boxes. Sunderland Forge & Engineering Co. and G. C. Reed. December 28th.

1915.

757. Wire Joiner, for the purpose of Connecting or Joining Telegraph or other Wires. J. Parker. January 18th.

937. Electric Light Prepayment Apparatus. H. S. J. Booth & W. Miller. January 20th.

1,689. Portable Electric Head Lamps. E. Ricci & G. Ricci. February 2nd.

4,079. Means for Collectively Actuating and Controlling Alternating-current Motors. J. L. Routin. March 15th. (Patent of addition not granted.)

5,865. Means for Starting Internal-combustion Engines. Robert Bosch (firm of). April 19th. (April 17th, 1914.)

9,682. Electrically-operated Change-speed Gear. Oesterreichische Daimler-Motoren Akt. Ges. July 2nd. (July 14th, 1914.)

Smoke Abatement.—The Manchester Air Pollution Advisory Board is endeavouring to obtain a grant to assist in the research work now being carried on by the Board with domestic heating appliances, and has decided to ask the Manchester Association of Engineers to apply to the Privy Council for a grant of £300 for the purpose.